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THE APPLICATION OF AUTOMATIC DATA PROCESSING TO THE SCHEDULING OF REAL PROPERTY MAINTENANCE

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Darrell U. Davidson

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by

Darrell U. Davidson
Major, United States Marine Corps

Submitted in partial fulfillment of
the requirements for the degree of

MASTER OF SCIENCE
IN
MANAGEMENT

United States Naval Postgraduate School
Monterey, California

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This work is accepted as fulfilling
the research paper requirements for the degree of
MASTER OF SCIENCE
IN
MANAGEMENT
from the
United States Naval Postgraduate School

ABSTRACT

Work scheduling is one of the cornerstones of a well managed real property maintenance program. This study addresses itself to the master work scheduling aspect of the Marine Corps Maintenance Management Program. This function has recently become more complex with the imposition of additional constraints. A computer based system consisting of a punched card job data library, computer programs and associated routines is proposed. The system is considered sufficiently developed for a pilot test project. Though the computer programs are based upon the IBM 1401 data processing system, the treatment of maintenance scheduling variables has application to any computer oriented approach to the problem.

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CHAPTER I

BACKGROUND

In November 1959, after an eleven-month test of a pilot project, the Marine Corps implemented its Maintenance Management Program[1] at all Marine Corps managed installations. Its objectives and procedures were essentially the same as those of the Controlled Maintenance Program developed by the Bureau of Yards and Docks and installed earlier or during the same period at Naval activities. That is, the goal was the application of sound management planning and control techniques to the efforts of real property maintenance organizations. In addition, it provided the unifrom approach to real property maintenance which was required for Headquarters, U. S. Marine Corps, to be responsive to Congressional and Department of Defense requirements. Though involving a substantial overhead investment, the program offered the greatest promise of continued maintenance support in the face of level funding with rising costs and increasing plant investment.

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[1]This program was originally published for guidance in the Facilities Maintenance Manual, NAVMC P-1092-ED, of November, 1959. This manual was subsequently revised slightly and included in the directives system as Marine Corps Order P11000.4A under the same title. Though the program has no specific title, it will be referenced herein as the Maintenance Management Program.

The essence of the program is the handling of maintenance work in much the same manner as custom production work in industry. In this sense the program has capitalized upon the industrial engineering experience of the Services and private manufacturers. However, the extension of these techniques to maintenance and repair work has been pioneered by the military departments.

I. PRESENT SYSTEM

Operations Division. The essential feature of the Maintenance Management Program is the functioning of the Operations Division of the station Maintenance Department. This unit performs the necessary staff services of work detection, planning, scheduling, and control. Specifically, the following functions, considered essential elements of a successful maintenance program, are included:[2]

1. Inspection
2. Work classification
3. Work input control
4. Job authorization
5. Material coordination
6. Planning and estimating
7. Shop scheduling
8. Reports

---

[2]U. S. Bureau of Yards and Docks, Navy Civil Engineer, III (February 1962), p. 32.

Figure 1 is an organizational chart of a typical maintenance department and shows the relationships between the Operations Division and the maintenance shops, or work centers,[3] which perform the work under the Maintenance and Repair Division. Figure 2 illustrates the organization of a typical operations division. Neither of these are to be considered as prescribed standards. Rather, they are representative and serve for illustrative purposes. A brief description of the activities of each unit of the Operations Division is in order to provide a background for subsequent discussion.

Inspection Unit. Ideally, the Inspection Unit is the point of origin for the preponderance of work accomplished by the Maintenance Department. The concept of detection of work requirements prior to breakdown is a basic premise of the Maintenance Management Program. All facilities are inspected on a regularly scheduled basis and corrective needs prescribed. In addition, this branch validates work requirements generated by other organizations.

Work Reception Unit. The Work Reception Unit is the initial receiving point for all work requirements. This may be in the form of work generated by the Inspection

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[3]Throughout this paper the terms "shop" and "work center" are used interchangeably.

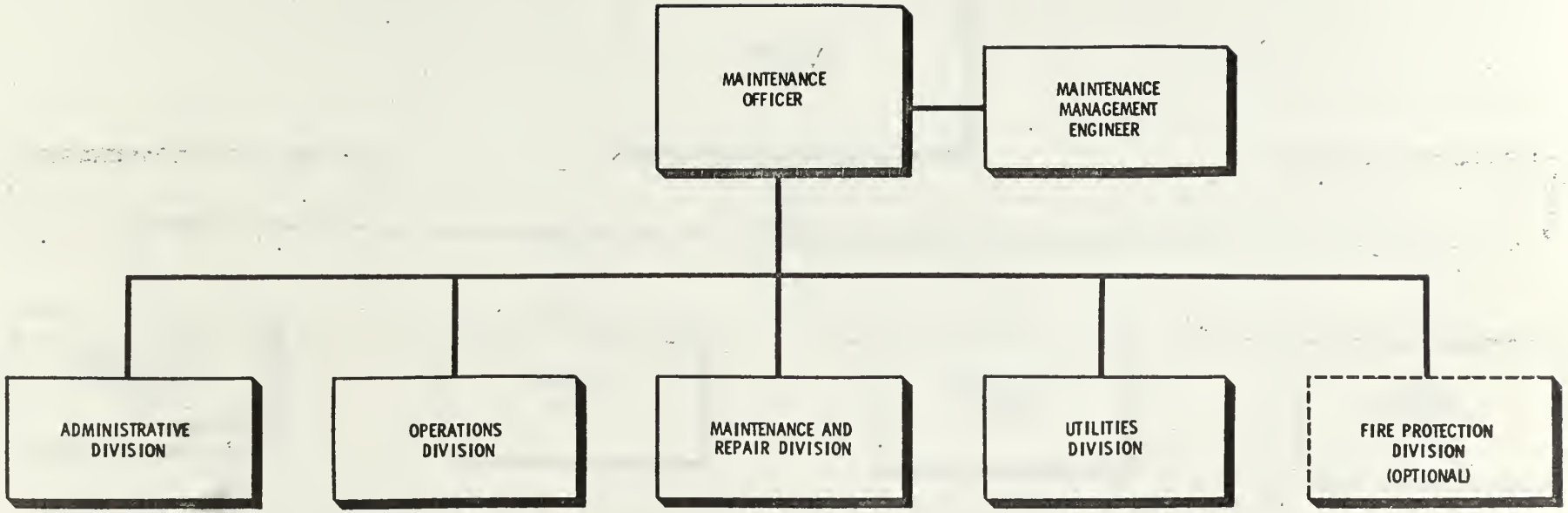


FIGURE 1

MAINTENANCE DEPARTMENT

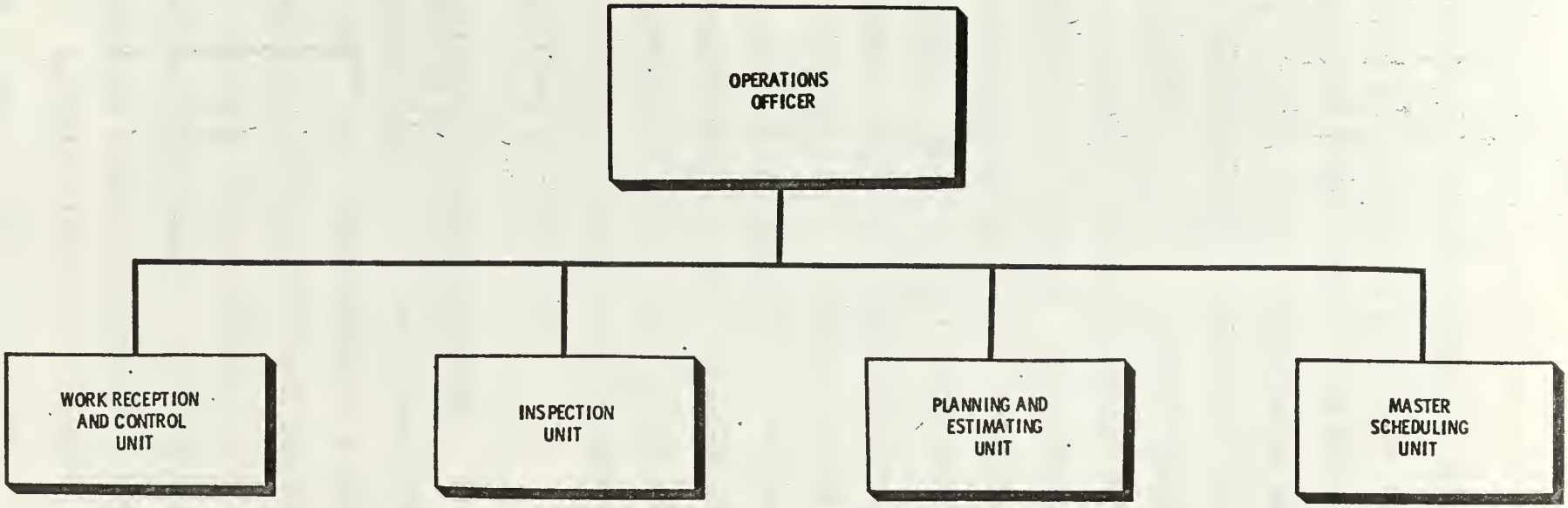


FIGURE 2

OPERATIONS DIVISION



Unit, written requests from organizations served, telephone requests for emergency work, and requirements originating within the Department. The Work Reception Unit must record receipt of the requirement and enter it into the control system so that tracer and follow-up action can be accomplished and a record of progress maintained. A variety of systems for establishing this paperwork control are feasible and in use. All involve the assignment of an identifying control number to each request.

An initial evaluation of all work is made by this Unit. Emergency work and minor service jobs requiring less than 16 manhours to complete can be authorized by this Unit. As indicated earlier, routine maintenance requests originating outside the Department are referred to the Inspection Unit for validation of work requirements. Most of the work requirements are forwarded to the Planning and Estimating (P&E) Unit.

Planning and Estimating Unit. The P&E Unit analyzes the work requirements and groups work into work packages--specific jobs. The composition of a job is a function of several variables among which are the nature of the work, the amount of work, the duration of the job, and funding and accounting requirements. Job estimates are developed using engineered labor performance standards whenever available. Material lists and specifications are prepared and become a part of the job estimate.

Scheduling Unit. Completed specific job estimates are forwarded to the Scheduling Unit where they are placed in the queue to await accomplishment. At the appropriate time, job estimates are selected for authorization as job orders. Jobs are then scheduled for completion by the work centers subject to the availability of materials, manpower, and funds. These activities are under the control of a master scheduler. Inasmuch as this study is focused upon the scheduling function, it will be described in much more detail below.

Operations Officer. The Operations Officer coordinates the efforts of the Operations Division. Within limits, he has work authorization authority. The extent of this authority, the degree of his participation in the chain of approvals associated with each job, and his voice in departmental policy is largely a function of the individual incumbent of this position.

II. THE SCHEDULING PROCESS

From the inception of the Maintenance Management Program, the scheduling function has been beset with difficulties in execution. Since the work schedule is the focal point of the desired performance control and evaluation, weakness here has serious implications for the entire program. To understand the nature of the problem, a

more detailed discussion of the scheduling sequence is necessary.

Managing the backlog. Beginning with the receipt of the completed job estimate from the P&E Unit, there is a requirement to keep track of this paperwork until it is prepared into a job order. Managing this backlog requires much more than just a filing operation. Some ready reference to each job, its urgency, and its labor and material requirements must be maintained. At the proper time, jobs must be selected from this backlog and prepared for issuance as job orders. The timing of this selection, or activation, is a key decision point. It is important that it be early enough to insure material is available when it is desired to start work. Further, it is necessary that the pool of activated work be sufficient to provide a backlog of work for all shops. However, this backlog must also be kept as small as possible since sound management must view an approved job order as a financial commitment. Allowing the pool of activated work to grow larger than is absolutely necessary substantially reduces the financial flexibility of the Department.

Job selection. Once activated, the job must be given even more attention than when a part of the backlog. Steps must be taken to schedule the commencement of work as soon as appropriate. Selection from the pool

of activated work those jobs to be worked has been the focal point of much of the criticism of the Maintenance Management Program. Current doctrine recognizes only two priorities of work, routine and urgent.[4] This doctrine emphasizes a first in, first out (FIFO) sequence. Many maintenance managers have found strict FIFO an unacceptable approach. This has, in turn, led to accusations of capriciousness in work selection. The question of essentiality is also related to job selection. A recent management study of Department of Defense real property maintenance activities was critical of the lack of uniform standards of essentiality in work selection.[5]

Work planning. Once the jobs have been selected, the actual act of scheduling a shop for work is straightforward and uncomplicated provided adequate information has been provided in the job order (job estimate). Some jobs may have to be worked sequentially by the work centers while others can be worked simultaneously. Such details, as well as total labor requirements and rate of work must be included by the P&E Unit in the job estimate.

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[4]U. S. Marine Corps, Facilities Maintenance Manual, MCO P11000.4A, (Washington: 1963), p. 5-15.

[5]Albert Ramond & Associates, Evaluation of Real Property Maintenance Activities (RPMA) for Department of Defense. Citation is from a synopsis of this report furnished to attendees at the Defense Real Property Maintenance Management Conference held at Warrenton, Virginia, in September, 1964.

The mere fact that a shop is scheduled for work does not insure that the work is actually accomplished. There are numerous reasons, justified and unjustified, for failure to meet a particular schedule. In fact, variation will be the usual case. Therefore, there must be a feedback of performance information to the master scheduler so that subsequent schedules can be adjusted accordingly. In addition, this feedback is required to provide management a basis for judgement of performance.

Weekly schedules. Work schedules are prepared on a weekly basis. The usual procedure is to have a tentative schedule for the following work week prepared by Thursday afternoon of each week. At that time it is discussed in a meeting with shop supervisors or planners, and necessary adjustments are made. The firm schedule is then prepared and published to each shop by Friday noon. This permits shop personnel some time for planning Monday work.

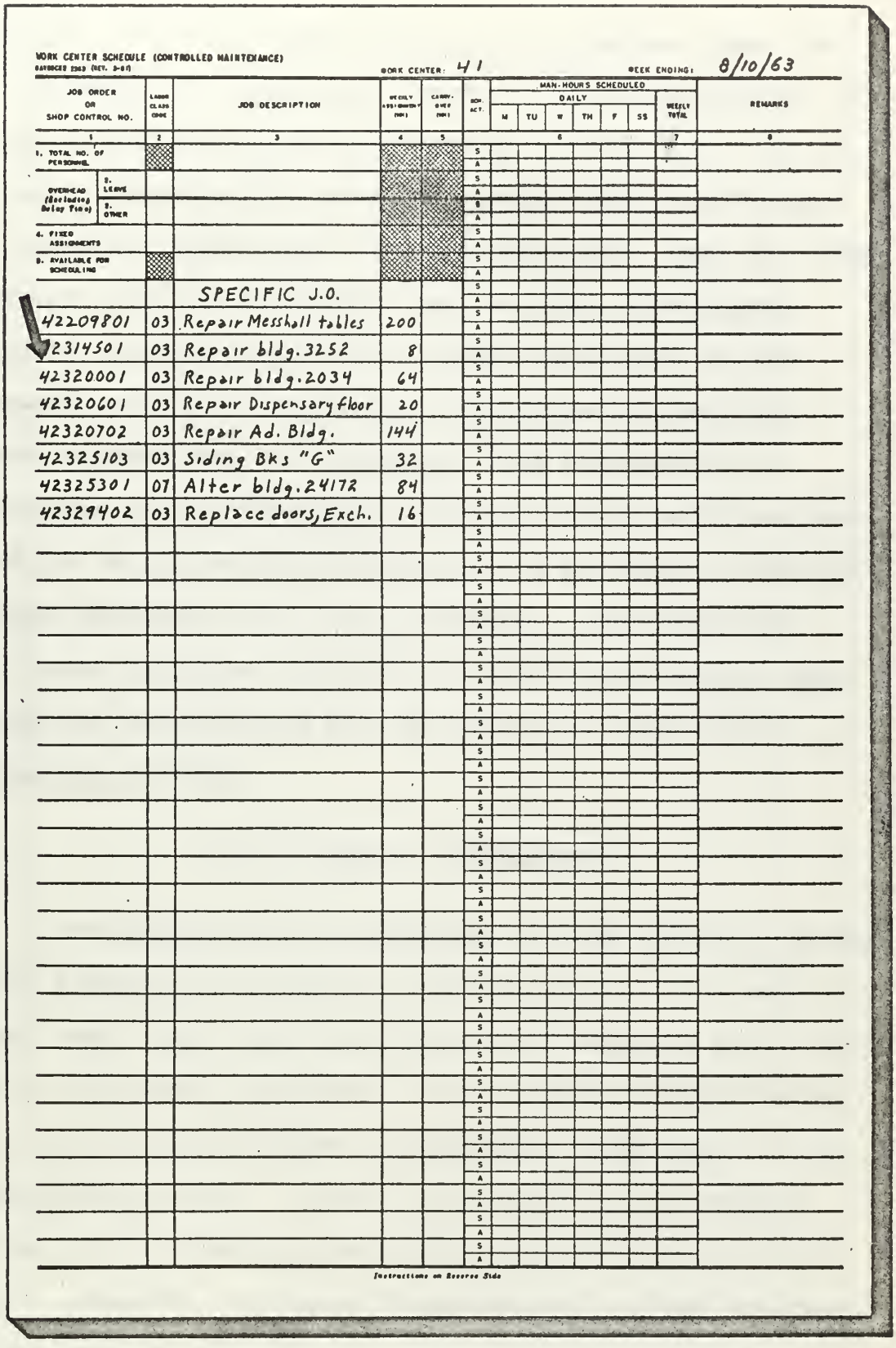
In preparing this schedule, the master scheduler must have data on the manpower availability in each shop. Not all the shop force is available for scheduled specific jobs. In addition to deduction for supervision, leave, overhead, and fixed assignments, a portion of the work force is left free of scheduled commitments to handle emergency and minor service work. The per cent of available productive labor which can be scheduled varies from

one shop to another, but a 75% average is probably a realistic goal.

A number of methods for communicating this weekly master schedule to the work center are available. Figure 3 depicts a standard form designed for this purpose. A seperate form of this type is prepared by the master scheduler for each shop, or by the shops on the basis of a master document. Another system uses a larger chart and shows all work scheduled for all shops. It is duplicated by the Ozalid process and a copy furnished each work center.

Status keeping. Just as there are a variety of ways to communicate the schedule to the work centers, there are a number of techniques for keeping track of the status of jobs on the work schedule and those awaiting scheduling. Visual display boards, some with moveable components for updating, have been popular and helpful to some operations. They have the disadvantage of requiring a substantial investment of time in maintaining them in a current status. Further, in a large scale operation their size tends to obscure the information portrayed and the value is lost. Card files have also been used alone or in conjunction with status boards.

Summary. From the foregoing discussion it can be seen that there is heavy clerical content in the scheduling



WORK CENTER SCHEDULE (CONTROLLED MAINTENANCE)

WORK CENTER: 41 WEEK ENDING: 8/10/63

JOB ORDER OR SHOP CONTROL NO.	LABOR CLASS CODE	JOB DESCRIPTION	WEEKLY ASSIGNMENT (MH)	CARRY-OVER (MH)	SCH. ACT.	MAN-HOURS SCHEDULED DAILY M	TU	W	TH	F	SS	WEEKLY TOTAL	REMARKS
1	2	3	4	5		6						7	8
1. TOTAL NO. OF PERSONNEL					S								
					A								
OVERHEAD (Excluding Delay Time) A. LEAVE					S								
					A								
B. OTHER					S								
					A								
4. FIXED ASSIGNMENTS					S								
					A								
5. AVAILABLE FOR SCHEDULING					S								
					A								
		SPECIFIC J.O.			S								
					A								
42209801	03	Repair Messhall tables	200		S								
					A								
42314501	03	Repair bldg. 3252	8		S								
					A								
42320001	03	Repair bldg. 2034	64		S								
					A								
42320601	03	Repair Dispensary floor	20		S								
					A								
42320702	03	Repair Ad. Bldg.	144		S								
					A								
42325103	03	Siding Bks "G"	32		S								
					A								
42325301	07	Alter bldg. 24172	84		S								
					A								
42329402	03	Replace doors, Exch.	16		S								
					A								

Instructions on Reverse Side

FIGURE 3

WORK CENTER SCHEDULE

Source: MCO P11000.4A



function. Of more significance, it is apparent that the work schedule is completely dependent upon the accuracy of the plans and estimates developed by the P&E Unit. These, in turn, are dependent upon the completeness and currency of inspection reports and, more importantly, upon the labor standards used in developing the job plan. Inaccurate estimates preclude realistic scheduling as well as the necessary growth of management confidence in, and work center respect for, the schedule. The application of engineered labor performance standards which have now been installed at all major activities is a key step in improving the dependability of job estimates. As experience with these standards broadens, it can be anticipated that estimating inaccuracies will no longer be significant scheduling problems.

III. FUNDING CONSTRAINTS

The discussion of scheduling to this point has given little attention to funding considerations. It is only in recent years that fund constraints have become a major concern to the master scheduler. This constraint has become so critical that it is now of paramount importance in any scheduling decision. In the first years of the program virtually all productive work was financed from one fund source. However, increased Congressional and OSD interest in real property maintenance costs, and the separate

identification of family housing have been the genesis of a proliferation of fund sources. That is, separate identification of funds through separate appropriations or budget projects within the Operation and Maintenance, Marine Corps, appropriation. Since the labor force is dependent for its financial support upon these numerous sources, the commitment of resources (to work) from each source in accordance with a definite plan has become a new and vital scheduling consideration.

The fact that this financial constraint has multiplied the number of scheduling steps by the number of fund sources has required additional personnel and data support for the scheduling function. The alternative to providing this support is regression to chaotic scheduling. As mentioned above, performance feedback data is a necessary element for future scheduling. However, where previously interest could be confined to weekly progress on specific jobs, multiple funding also makes it necessary to know weekly labor charges in each fund area.

IV. THE TURN TO AUTOMATIC DATA PROCESSING

It is against this background that the present study was undertaken. The objective was to demonstrate the potential of automatic data processing (ADP) techniques for handling the increasingly detailed scheduling problem and to develop an initial useable computer based system. The

turn to ADP for a solution is a natural step for a number of reasons.

1. The recent success of industrial applications of the computer to production control.

2. The high clerical content of the scheduling function. It is such routine work which is best suited to automation.

3. The fact that scheduling decisions appear reduceable to a series of comparatively easily identified dependent decisions.

4. The availability of ADP equipment at all major installations.

5. The unacceptability of meeting the increased detail of scheduling by expanding the number of personnel devoted to it.

Present ADP services. ADP is not a stranger to real property maintenance managers. Allotment and cost accounting systems have for some time been keyed first to EAM and more recently to the computer. Several regularly consulted management reports have been prepared by ADP. However, the support received has been largely limited to by-products of this accounting system. This study envisions the application of ADP in a more operational role than that associated with the present after-the-fact accounting reports.

Existing systems. No evidence was found of an operating ADP-based scheduling system for real property maintenance within the Department of the Navy. The author was aware of at least one Air Force installation in Texas that used a punched card system for authorization and control of some types of work.[6] A Navy sponsored effort by the Stanford Research Institute approached the problem but focused upon shop level rather than master scheduling. Though this study was Navy-based, the similarity between maintenance management programs is so complete that the study is equally applicable to the Marine Corps. The following excerpt explains the SRI position:

> The number of constraints involved in the above (master scheduling), together with other complicating factors makes it unwise, in our opinion, to contemplate thorough study or attempted overhaul of scheduling in the present contract. We observed it, discussed it with managers involved, and feel qualified even to make general statements about it. In another section of this report we discuss the possibility of automating this undertaking. Here, we take the position that this process is well-performed by experienced personnel, and that it would be an undertaking the scope of which is outside that of the present contract to overhaul the methods used by the master schedulers to match and equilibrate their shoploads.[7]

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[6]Statement made by Major General R.H. Curtin, Director of Civil Engineering, U. S. Air Force, in a conversation with the author, 1963.

[7]Stanford Research Institute, Scheduling Maintenance Activities of Public Works Centers with the Aid of Automatic Data Processing Equipment (Menlo Park, Calif.: Stanford Research Institute, 1965. Bureau of Yards and Docks contract NBy-32268 for Naval Civil Engineering Laboratory, Port Hueneme, Calif.).

The author readily agrees that the master scheduling system is complex. It could even be allowed that it is well performed at some locations. However, it is contended that there is a universal need for assistance in the face of multiplying requirements.

V. SUMMARY

The work scheduling function is one of the cornerstones of the Marine Corps Maintenance Management Program. Maintenance work scheduling has always involved complex considerations, but the problem has been compounded by recent fractionations of applied funds. Automatic data processing appears to offer a promising means of coping with the increased complexity. No evidence has been found of previous work on this specific problem.

CHAPTER II

PROJECT OBJECTIVES AND CONSTRAINTS

The objective of this study, already stated in part in Chapter I, was as follows:

> To develop a computer based system of procedures to accomplish the scheduling of real property maintenance work within the Marine Corps Maintenance Management Program.

I. ORGANIZATION OF THE STUDY

Conduct of the study consisted of a number of subordinate tasks which were undertaken in the order listed below.

1. Establishment of constraints, procedures, and guidelines.
2. Specification of desired outputs.
3. Identification of variables.
4. Selection of an algorithm.
5. Specification of inputs.
6. Computer programming.
7. Preparation of a simulated job library.
8. Test of the system.
9. Identification of potential refinements.

Each of these phases will be discussed in varying detail in this and succeeding chapters.

II. STUDY CONSTRAINTS

As a point of departure it was first necessary to prescribe some general constraints, guidelines, and assumptions for the conduct of the project. Inasmuch as the objective of the project implicitly included the development of a computer program or programs which would be useable with limited modifications, certain of these constraints naturally followed.

Data processing system. It was determined that the project should be based upon the International Business Machines (IBM) 1401 data processing system. Although a Control Data Corporation 1604 system was also available, the choice of the 1401 was natural since this is the equipment in use at all major Marine Corps installations. Specifically, the 1401 system utilized contained the following equipment.

1 - 1401 Processing Unit

1 - 1406, Model 3 (16,000 character), Storage Unit

1 - 1402 Card Read-Punch

1 - 1403 Printer

2 - 729 Magnetic Tape Unit

Although the system was also equipped with the 1311 Disk Storage, this feature was not used since it is not widely available at Marine Corps installations.

Programming language. All programming was done using the Symbolic Programming System (SPS) for the IBM 1401. This presented a formidable learning task for the author since he had no previous exposure to this language. Though FORTRAN II, with which the author had some familiarity, was available, it was rejected. The reasons were its mathematical orientation which was not of significance in the programs contemplated, the uneconomical (of program steps) method of handling conditional branches, the loss of much of the variable word length advantage of the 1401, and the nonavailability of subroutines. Further, the extent of its availability throughout the Marine Corps was unknown.

Scenario. It was decided that the programming and subsequent test of the system should be based upon a hypothetical maintenance department with simulated jobs rather than upon a department at a specific installation. It was hoped that this would avoid the pitfall of becoming excessively involved in programming for local details which would contribute little to the general solution. A department with eight scheduleable work centers and eight fund sources was selected as the hypothetical model. This is more than adequate to include most existing departments.

Keypunch availability. The availability of keypunch equipment within the maintenance department was assumed. Acquisition of keypunch, if not already on hand, is considered essential to support the system developed herein.

Savings desired. Any system for accomplishing work scheduling should not impose additional burden upon the work centers for input information. Further, a personnel reduction in the Operations Division is desireable. An increase could be justified only by the clear demonstration of the immediate overall savings to be realized.

III. OUTLINE OF THE SYSTEM

Following delineation of constraints, it was necessary to sketch in general terms the structure of the system. Emphasis was placed upon developing a system of routines which would involve a minimum of modifications of existing Operations Division organization and procedures. A system capable of manual operation in an emergency was sought. This consideration plus the restriction to use of present ADP equipment, discussed above, limited the choice of outputs and inputs to printed reports and punched cards. A system with the following provisions was envisioned:

1. Cognizance over all specific jobs which are planned and estimated. This included estimates pending

approvals from outside the Department. It excluded all work in the emergency, minor service, and fixed assignment categories which are not included in present scheduling.

2. A punched card library of information on all jobs under the cognizance of the scheduling system.

3. A printed work schedule output which would indicate to each work center the labor to be applied to each scheduled job during a one week period.

4. A periodically revised printed listing of all jobs under the cognizance of the system with details of the job and its current status.

5. Periodic printed reports of all work in the backlog to serve the master scheduler and management.

6. An information feedback provision to continuously inject actual performance data into the system.

7. Emphasis upon automatic updating of the punched card library.

IV. SYSTEM NAME

To emphasize that the project contemplated the development of a complete system and not just a computer program, the attachment of a name to the system was considered appropriate. In addition, the name would assist in eliminating any confusion in whether the total system or only one of the computer programs was being referenced.

The name "Autosked", formed by attaching the "auto" prefix to the phonetic abbreviation for the word "schedule", was considered descriptive and appropriate.

CHAPTER III

OPERATION OF THE SYSTEM

This chapter is an overview of the operating features of the Autosked system as developed by this study. Later chapters are devoted to an examination of the most significant details of the system.

I. SYSTEM MANAGEMENT

Autosked is managed by the master scheduler in the Operations Division. His primary concern revolves about a punched card Library Deck of information on all jobs under the cognizance of the Autosked system. He must insure that this data bank reflects the latest information on each job. In addition, he monitors work requirements as they are received or completed and makes manual adjustments as necessary during the work week to allow for circumstances not provided for within the system. At the appropriate times he delivers the Library Deck and other input data to the computer center for processing. He receives and distributes the outputs generated by the computer processing.

Scheduling cycle. Autosked, like the present manual system, involves a weekly cycle. The highlights of the Autosked cycle are:

1. Preparation of the Shop Work Schedule for the forthcoming week after the performance results for the current week are known.

2. Preparation of a Job Listing and two Work Backlog Reports on Monday or as soon as the Shop Work Schedule has been prepared and its impact reflected in revisions posted to the Library Deck.

3. Preparation of a Tentative Shop Work Schedule for the forthcoming week on Thursday morning for use at the Thursday afternoon scheduling meeting.

This cycle is depicted in Figure 4. The following description of Autosked operation will adhere to the sequence shown in the figure.

Library Deck. As job estimates are received in the Scheduling Unit from the P&E Unit, data is extracted and punched into a set of ten data cards. These are identified as a Master Card, a Job Description Card, and eight Shop Cards, one for each work center. A card is required for a work center even though it does not have work on a particular job. Figure 5 is a ten-card set for one job. The set must be maintained in the sequence shown; that is, Master Card, Job Description Card, and Shop Cards for Work Centers #1 through #8.

This set is hand-inserted into the Library Deck which is a collection of such sets for all jobs included

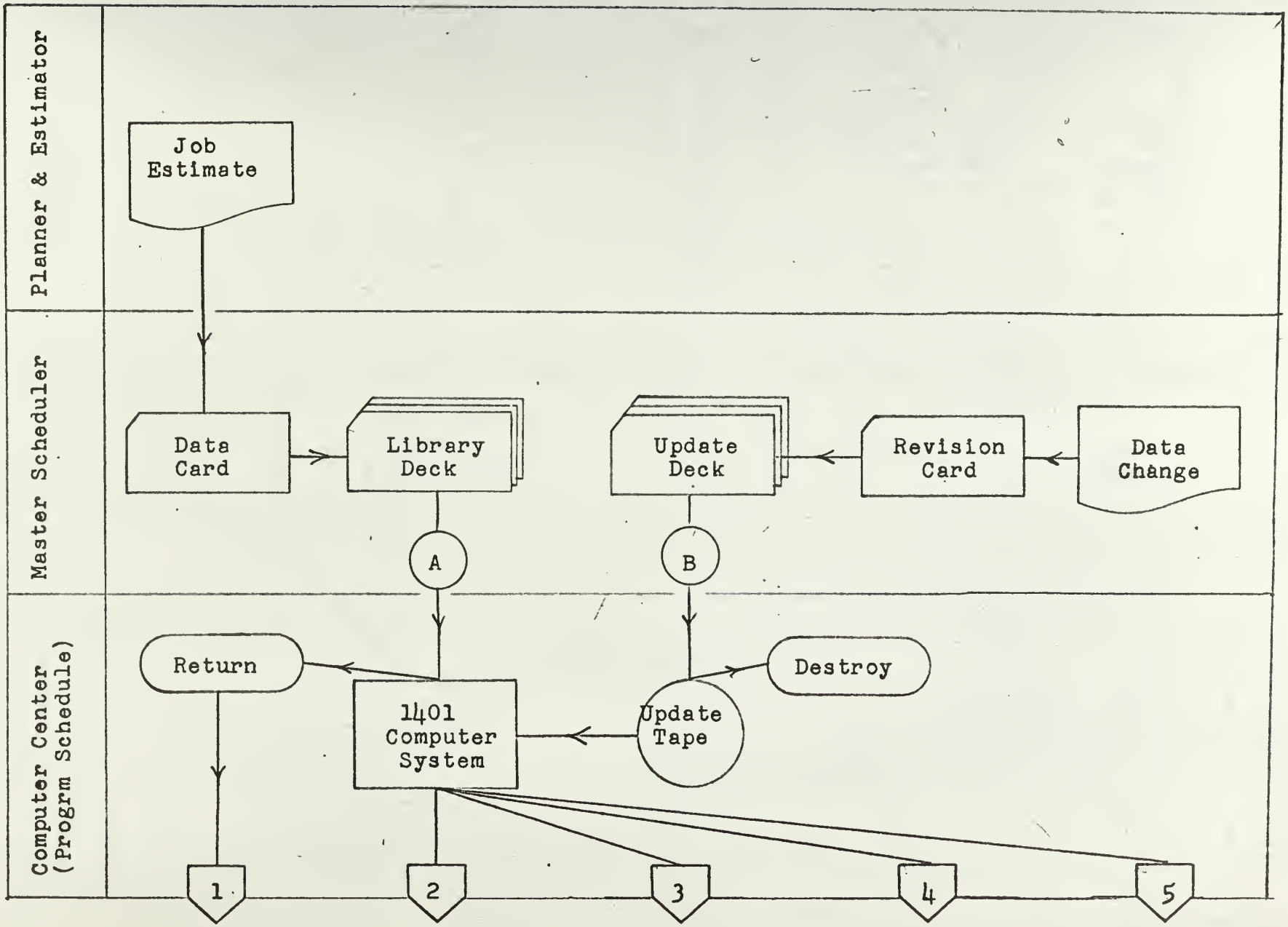


FIGURE 4e. AUTOSKED SYSTEM CYCLE

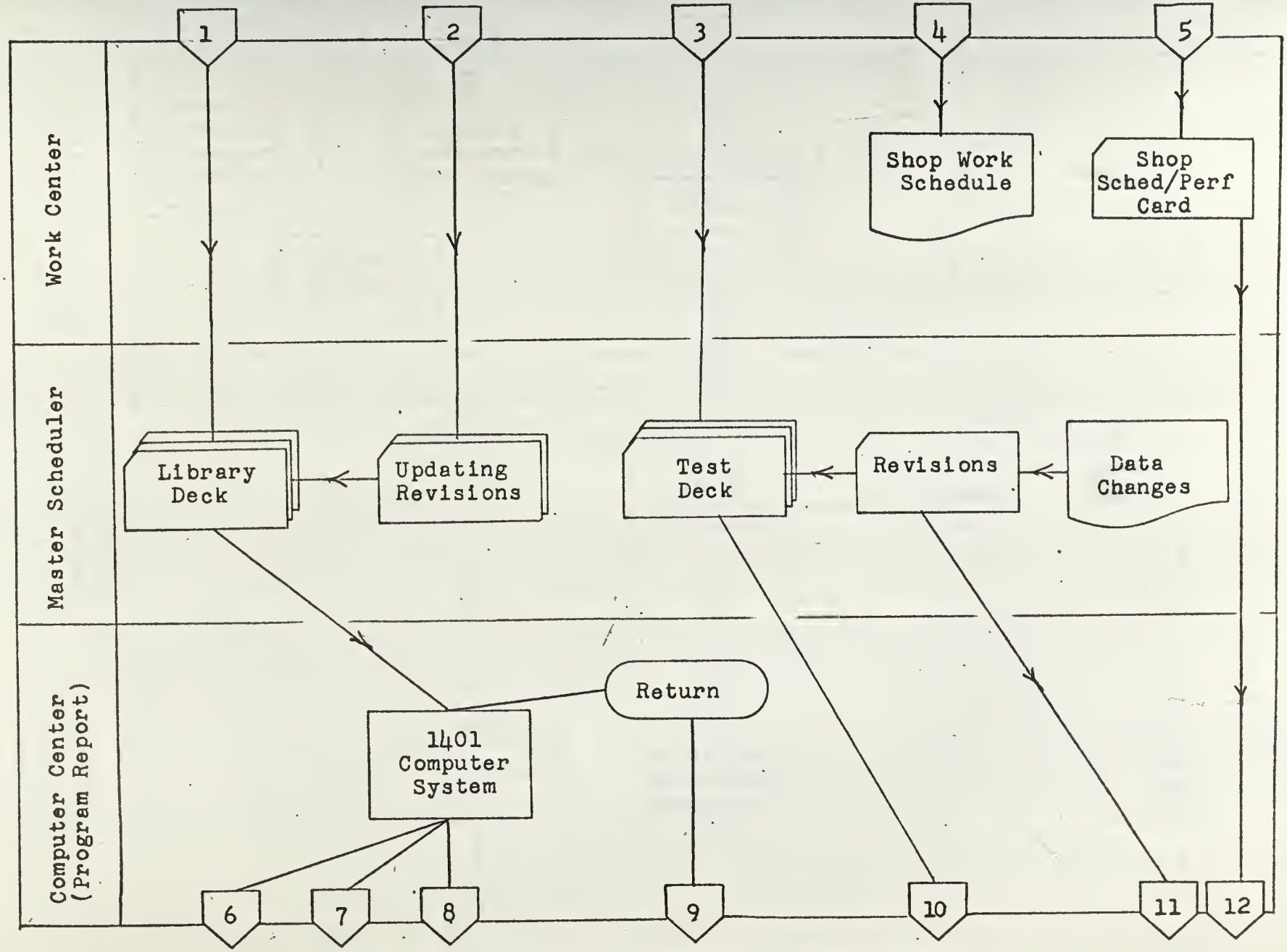


FIGURE 4b. AUTOSKED SYSTEM CYCLE (Continued)

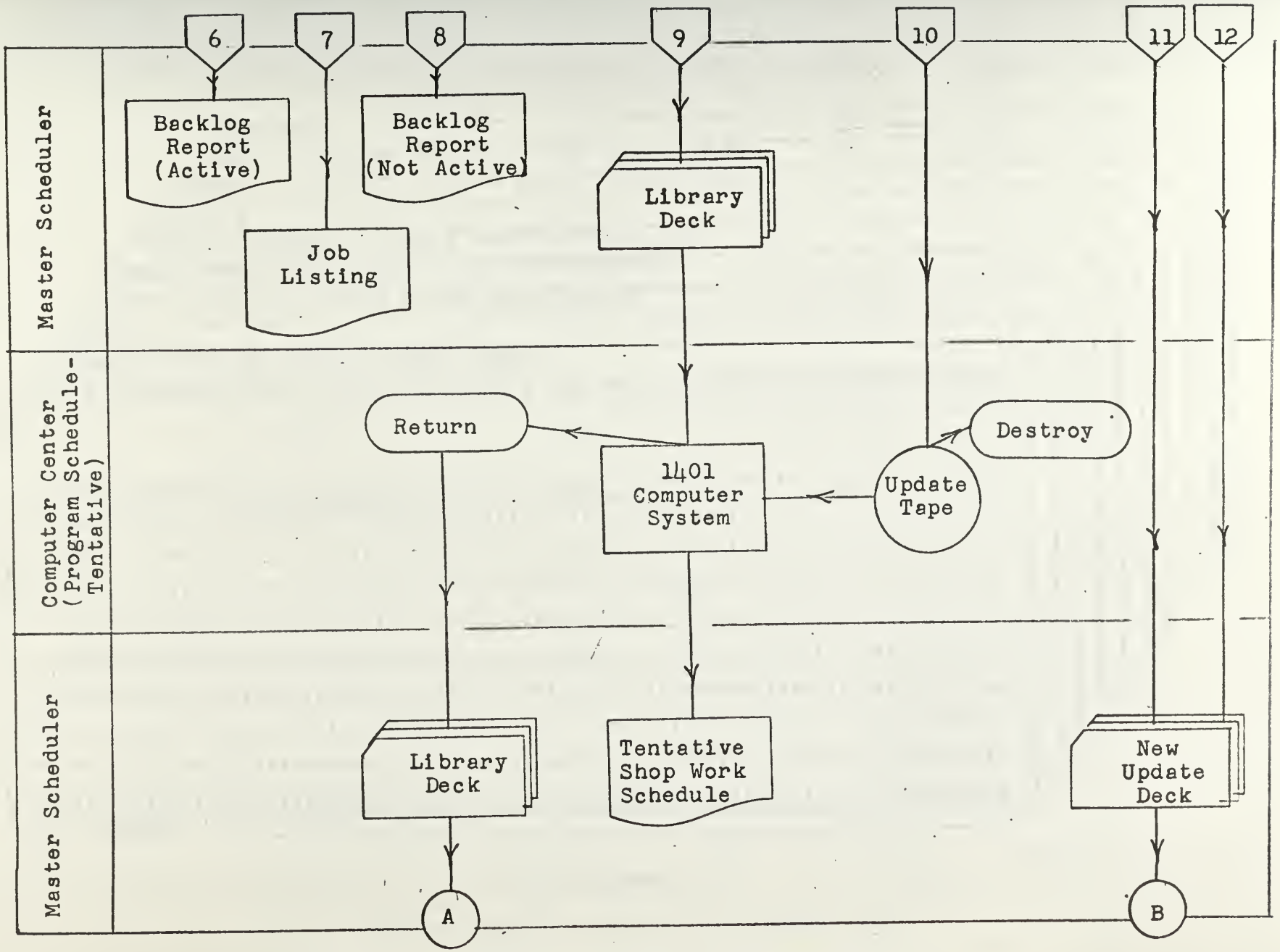


FIGURE 4c. AUTOSKED SYSTEM CYCLE (Continued)



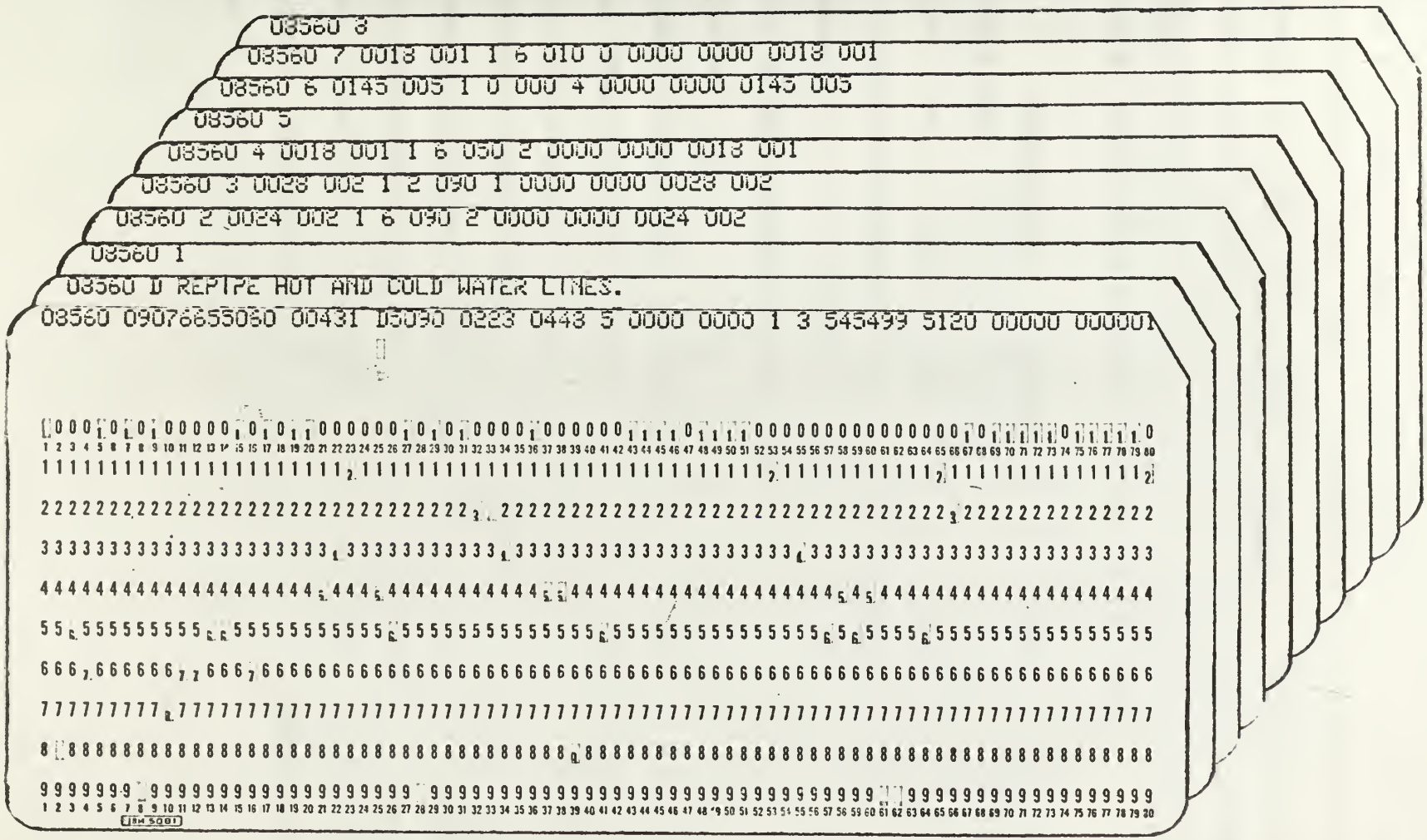


FIGURE 5

TEN-CARD SET FOR ONE JOB IN LIBRARY DECK

in the system. Jobs are identified throughout the system by a five-digit control number punched into the first five columns of each data card. Job sets must be placed in the Library Deck in control number sequence. Failure to do so will cause erroneous outputs from the computer programs. Chapter IV is devoted to a detailed description and discussion of the data contents of the Library Deck.

Update Deck. Supplementing the Library Deck is the Update Deck. Its sole purpose is to serve as a temporary repository for data to modify or amend the Library Deck. This data is injected into the Library Deck during the execution of the computer programs. The bulk of the Update Deck is Shop Schedule/Performance Cards which will be discussed later. In addition, the Update Deck is the primary vehicle for posting changes in status, priority, and other job data to the Library Deck. A typical occasion for revision would be upon activation of a job. The new data is punched into the proper field in an appropriately identified Master or Shop Card and the card hand inserted into the Update Deck. As an alternative, the Library Deck can, of course, be modified by a direct card replacement. However, this procedure requires more manual operations and is, therefore, more subject to error.

II. SCHEDULE PREPARATION

The work schedule for the forthcoming week is prepared at the computer center at the end of each work week, Friday unless a holiday is involved. This requires work after normal working hours on Friday for a portion of the Scheduling Unit and assumes two-shift operation of the computer center. If this is unacceptable, the work schedule can be prepared Monday morning with a sacrifice of some planning time by the shops.

Input data preparation. The Library and Update Decks and a set of five parameter cards are delivered to the computer center for processing. The Update Deck is processed first to transfer the contents to magnetic tape. The card-to-tape program required should be available in the computer center library and has not been included in the programs for Autosked. Once transferred to tape, the Update Deck can be destroyed. However, retention on file for a period of time is recommended to maintain a record and to facilitate tracking in case of errors.

The Library Deck is processed by executing Program Schedule. The Update Tape is mounted on Unit #1 and a scratch tape on Unit #2. The five parameter cards introduce additional information required by Program Schedule. This includes:

1. The date and number of days in the work week.

2. Season information.

3. Constants used in rank ordering jobs.

4. Manhour availability in each work center.

5. Minimum and maximum limits for each fund source.

Shop Work Schedule. Program Schedule generates both printed and punched card outputs. The printed output is the Shop Work Schedule for the forthcoming week. Figure 6 is a sample last page from a Shop Work Schedule. Jobs appear in control number sequence. The fund source from which the job is financed is identified. The payoff is used to rank order the jobs. Its calculation is discussed in Chapters V and VI. The number of manhours scheduled for each of the eight shops on each job is given. Two dashes (--) in the manhour position signify that the shop has no work on that job. A blank indicates that the shop has work on the job but none is scheduled. The notation "FIN" means that the shop has finished its portion of the job. Each work center gets a copy of the entire schedule. This has the advantage of informing each shop of the total picture for each job, a shortcoming of the type form shown in Figure 3, Chapter I.

The last page only of the Shop Work Schedule will carry the manhour totals scheduled for each work center. This should total the availability prescribed by the parameter card. If this level is not scheduled, a notation of this fact is added at the bottom of the page. Manhour

SHOP WORK SCHEDULE FOR THE WEEK ENDING 21 MAY 1965

UNITS = MANHOURS

JOB	FUND	PAYOFF	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
8330	2	339		--	164	--	--	--	--	--
8772	7	503	32	--	--		--	--		--
8999	3	677	20	1		20	--	20	6	--
9489	2	341		--		--	--	--	16	--
9703	1	418	--	--	--		--		16	--
9945	4	502	8		--	--	--		--	40
10089	5	429	--	--	--	--	--	--	--	160
10547	8	335	29					--		--
10754	6	500	--	--	--	--	--	120	--	--
10767	2	668	24	--		--	--	--	--	--
10821	5	463	32	--		--	--	--	--	--
10823	2	453	131	8		34	18	10	--	--
11667	1	368	--	--	--	--	--	--	80	--
MANHOUR TOTALS =			390	77*	360*	300	140	170	280	810

FUND SOURCES	1	2	3	4	5	6	7	8
MANHOUR TOTALS =	202	816	67	128*	622	120	500	72

* = INSUFFICIENT ACTIVATED WORK TO MEET SPECIFIED REQUIREMENTS

FIGURE 6

SHOP WORK SCHEDULE

totals scheduled for each of the eight fund sources are also given on the last page. These totals should fall between the prescribed minimums and maximums. If a minimum is not met, an asterisk and the appropriate note are added.

Shop Schedule Performance Cards. Three different punched card outputs are generated by Program Schedule. The punch hopper should be loaded with blank cards printed with the Shop Schedule/Performance Card format. This, of course, means that all cards punched will be on this form which is applicable to only one of the three different outputs. This will not impair the use of the other two outputs, however.

The Shop Schedule/Performance Card, Figure 7, goes to the work center with the Shop Work Schedule. It contains all the data of a Shop Card plus the number of manhours scheduled for the week and the date of the last working day of the week. When the card is received in the shop, the Hours Worked field is blank. At the end of the week the shop supervisor writes in the number of manhours actually worked and returns the card to the master scheduler. The Hours Worked field is punched into the card. As indicated earlier, these combined Shop Schedule/Performance Cards make up the bulk of the Update Deck.

In recognition of the fact that estimates of job manhours and workday duration are subject to some

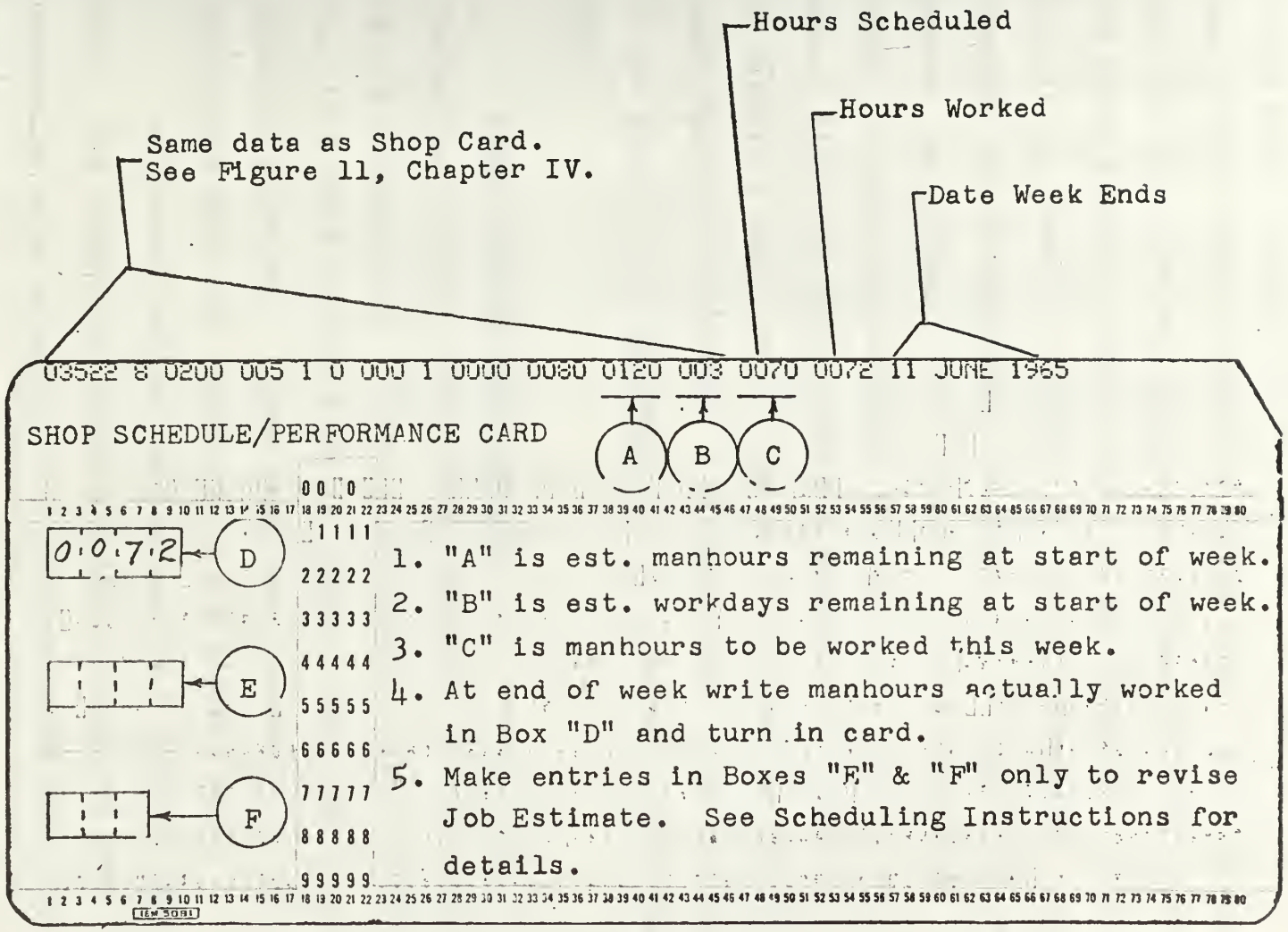

Hours Scheduled
Hours Worked
Same data as Shop Card.
See Figure 11, Chapter IV.
Date Week Ends
03522 8 0200 005 1 0 000 1 0000 0080 0120 003 0070 0072 11 JUNE 1965
SHOP SCHEDULE/PERFORMANCE CARD
A
B
C
0 0 7 2
D
E
F
1. "A" is est. manhours remaining at start of week.
2. "B" is est. workdays remaining at start of week.
3. "C" is manhours to be worked this week.
4. At end of week write manhours actually worked in Box "D" and turn in card.
5. Make entries in Boxes "E" & "F" only to revise Job Estimate. See Scheduling Instructions for details.

FIGURE 7

SHOP SCHEDULE/PERFORMANCE CARD

inaccuracy, the shop supervisor may communicate to the scheduler his estimate of actual work remaining by means of the Shop Schedule/Performance Card. This is done by completing blocks "E" and "F" on the card. This is warranted only when the shop supervisor recognizes that posting the Hours Worked, which is done by the computer, would result in an incorrect picture of the work remaining. For example, if the shop were scheduled for 64 hours and completed its portion of the job, but did not use all 64 hours, it would be necessary to report the revised estimate. Block "E" would show 000 manhours and block "F" 00 mandays. These entries serve as a signal to the keypunch operator to prepare a revision card to be included in the Update Deck <u>following</u> the Shop Schedule/Performance Card.

<u>Other Punched Card Outputs</u>. The second type of punched card output from Program Schedule is revisions to the Library Deck. These cards reflect data inserted via the Update Deck as well as changes resulting from the scheduling process. These cards are delivered to the Scheduling Unit for insertion in the Library Deck.

The third punched card output is a special Test Deck. Its format and purpose will be explained later in connection with preparation of the Tentative Shop Work Schedule.

JOB LISTING--CONTROL NO. AS OF 18 MAY 1965

ORIG. NO.	DATE	PRIOR.	FUNC	JOB	RELATED CNTL NOS.	STATUS
228	FACILITY=MCASG JOB= CLEAN ALL CATCH BASINS AND DO DRAINAGE WORK.					
26	359-64	4170	5	7	00000 00229 00000	IN APPRCVED BACKLOG AWAITING ACTIVATION
288	FACILITY=02014 JOB= INSTALL WIRE MESH ON 3 CELL BLOCKS					
49	17-65	4192	9	3	44006 00000 00000	ACTIVATED AWAITING SCHEDULING
740	FACILITY=2910C JOB= REPAINT LOWER FLOOR ROOMS.					
05	111-65	4200	4	5	C0000 00000 00000	IN APPRCVED BACKLOG AWAITING ACTIVATION
983	FACILITY=MCASG JOB= REMOVE WEEDS FROM HELO LANDINGS AND RUNWAY OVERRUNS. STERILIZE AREA.					
26	358-64	4155	5	7	40510 00000 00000	ACTIVATED AWAITING SCHEDULING
1007	FACILITY=ROADS JOB= REPAIR ASPHALT ROADS.					
10	44-65	4204	5	2	00000 C0000 00000	IN APPRCVED BACKLOG AWAITING ACTIVATION
1301	FACILITY= 3252 JOB= MOVE PAINT SPRAY BOOTH					
12	116-11	5111	9	1		DEFERRED BY MAINTENANCE OFFICER
1338	FACILITY=ORLPR JOB= CONSOLIDATED MINOR WORK TO REAL PROPERTY.					
16	125-65	5104	4	2	45022 00000 00000	ACTIVATED AWAITING SCHEDULING
1670	FACILITY=MISCL JOB= REPLACE ELECTRIC PANELS IN 27 C-PITS.					
12	9-65	4210	6	2	00000 00000 00000	IN APPROVED BACKLOG AWAITING ACTIVATION
1877	FACILITY=ROADS JOB= REPAIRS TO ROADS AND SIDEWALKS.					
09	34-65	4257	5	2	C0000 00000 00000	IN APPRCVED BACKLOG AWAITING ACTIVATION
2443	FACILITY=02045 JOB= MISCELLANEOUS REPAIRS AND EXTERIOR PAINT.					
11	97-64	4240	6	2	00000 C0000 00000	IN APPRCVED BACKLOG AWAITING ACTIVATION
2584	FACILITY= 2112 JOB= INSTALL VENILATION SYSTEM					
16	834-70	5111	5	6		REIMBURSABLE WORK PENDING APPROVAL OF REQUESTOR
2892	FACILITY= HGRS JOB= INSTALL GROUNDING SYSTEM					
12	497-38	5111	3	7	45891	ACTIVATED AWAITING SCHEDULING

FIGURE 8

JOB LISTING

JOB LISTING-WORK BACKLOG (ACTIVATED, NOT COMPLETED) AS OF 18 MAY 1965

UNITS = MANHOURS * = HELD FOR MATERIAL

JOB	FUND SOURCE	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
4961	4	--	--	--	--	--	--	155*	--
5374	8	32	--	3	32	64	--	--	--
5887	2	--	--	--	--	32	--	--	--
6247	2	51	16	22	6	--	36	44	--
6705	3	24	--	6	--	--	--	--	16
6834	7	40	48	1195*	48	--	72	--	--
7073	2	200*	--	--	16	32	--	32	16
7751	3	71	--	18	53	4	--	--	16
8073	5	--	--	--	--	--	--	--	256
8177	2	12	--	--	--	--	4	2	--
8330	2	2	--	164	--	--	--	--	--
8494	2	95	--	68	--	--	--	--	--
8560	5	--	24	28	18	--	145*	18	--
8772	7	32	--	--	2*	--	--	56	--
8999	3	74	8	32	54	--	51	6	--
9489	2	44	--	162	--	--	--	33	--
9611	2	8	--	31	--	--	4	2	38
9703	1	--	--	--	54	--	64	16	--
9742	1	9	24	--	20	80	--	--	--
9945	4	8	40	--	--	--	32	--	40

FIGURE 9

BACKLOG REPORT (ACTIVATED, NOT COMPLETED)

JOB LISTING-WORK BACKLOG (NOT ACTIVATED) AS OF 18 MAY 1965

UNITS = MANHOURS * = MATERIAL ORDER REQUIRED

JOB	FUND SOURCE	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
8558	5	--	24	8	8	--	145*	8	--
8575	5	--	24	8	8	--	145*	8	--
8783	2	--	145	30	--	--	--	--	60
8798	2	24	16	8	16	16	32	16	--
8817	2	--	--	--	--	--	98	42	--
8880	2	87	3	43	36	--	48	11	32
9055	3	4	--	--	16	--	--	16*	--
9315	6	--	24	270*	--	--	--	--	--
9664	1	--	--	--	--	--	--	328	--
9685	8	--	--	--	--	--	--	--	352
9709	2	51	--	20	--	--	--	24	--
9858	1	--	--	--	--	--	160	64	48
9897	1	200	--	--	--	--	--	16	--
10088	5	--	--	120	--	--	--	--	--
10330	5	72	24	5	74	--	48	10	36
10331	5	286	128	136	2	--	--	60	188
10770	2	--	--	--	--	--	--	--	198
10882	2	--	--	--	--	--	--	--	128
MANHOUR TOTALS =		1977	693	1839	683	159	926	1637	4738

FUND SOURCES	1	2	3	4	5	6	7	8
MANHOUR TOTALS =	816	4251	36	951	4172	1056	654	616

FIGURE 10. BACKLOG REPORT (NOT ACTIVATED)

activation.(Figure 10). Each contains notations of special material considerations. As with the Shop Work Schedule, the last page of each Work Backlog report carries the man-hour totals for each of the eight work centers and the eight fund sources. These reports serve as working documents to the master scheduler and as management reports. In the short run they are the basis for Inspection Unit and P&E Unit work emphasis. In the long run they indicate the need for financial and manpower adjustment.

IV. TENTATIVE SCHEDULE PREPARATION

A weekly Thursday afternoon meeting between the scheduler and shop supervisors or planners is a part of the present system and is retained in Autosked. It is necessary that a tentative plan for the next week be available at this meeting. Further, since the firm Shop Work Schedule will not reach the work centers until Monday, they must have some basis for planning Monday work. The Tentative Shop Work Schedule fulfills these needs.

The Tentative Schedule is based upon the assumption that all work scheduled, no more or less, will be completed. It is prepared by executing Program Schedule with certain minor adjustments. The Library Deck and the five parameter cards are processed in the same way as in preparing a normal schedule. However, the punch routines are by-passed since the punch outputs are not normally needed in connection

with a Tentative Schedule. Console switch settings insert the word "Tentative" in the report heading and by-pass the punch routines.

Test Deck. The Test Deck generated during the previous execution of Program Schedule is used in place of the Update Deck. The Test Deck cards contain only control numbers, shop identification, the manhours scheduled and the date. The unique feature is the fact that the Work Scheduled field has been punched into the Work Completed field. Thus, Program Schedule treats it as accomplished. Since revisions which have arisen from data changes are pertinent to the Tentative Schedule, cards bearing this data must be merged into the Test Deck as is done with the Update Deck. As in the case of the Update Deck, the Test Deck can be discarded once it is transferred to magnetic tape. However, the best practice would be to retain it for a period for record purposes.

Projected schedules. Properly, master scheduling is concerned not only with the forthcoming week but with projection into the next several weeks. The Tentative Schedule procedures provide a means for accomplishing this forward planning. A series of Tentative Schedules can be prepared by repeating the computer program a number of times. In this case the punch outputs should not be by-passed and each repetition will generate a new Test

Deck. Of course, a new set of parameter cards would be required for each repetition.

V. SYSTEM DIMENSIONS

Computer core storage limitations. As presently programmed, computer core storage limits the capacity of the Autosked system. Methods for relief of this limitation are discussed in Chapter VI. From the standpoint of the Library Deck, there is no limit to the number of jobs which can be accomodated. This is also true of the Job Listing phases of Program Report. However, the Work Backlog Reports are dependent upon a core storage table of job information on those in the "activated" and "approved, but not activated" categories. A maximum of 240 such jobs can be accomodated within the core memory of a 16,000 character capacity unit. This serves to limit the size of the system to 240 jobs in these categories plus any number of jobs in other categories as described in Chapter IV.

In addition, Program Schedule uses a core memory table with a capacity of 125 jobs. However, these jobs are only those in the "activated" category. This serves as a subordinate limitation within the 240 jobs mentioned above.

Library Deck maintenance. The number of cards in the Library Deck is, obviously, ten times the number of

jobs under the cognizance of the system. The number of revisions which must be merged each week into the Library Deck is a function of the number and nature of jobs involved and must be considered highly variable. An estimate of the magnitude of the Library Deck maintenance task can be made through application of the following assumptions:

1. Full capacity of 125 activated jobs and 115 approved but not activated jobs plus 100 other jobs. Total is 340 jobs.

2. 40 to 50 jobs in process each week.

3. Average of two to three work centers involved each week on each job in process.

4. 30 to 40 jobs completed each week, an equal number received, and an equal number activated.

5. One job in three requires a special revision each week involving one card.

6. One Shop Schedule/Performance Card in four calls for a revised job estimate.

These assumptions lead to the following rough estimates of activity for certain tasks.

1. Keypunch

    a. 450 to 700 cards for new jobs, job activations and other revisions.

    b. 80 to 150 data insertions on Shop Schedule/Performance Cards.

2. Library Deck filing

   a. 30 to 40 insertions of ten-card sets for new jobs and an equal number of removals for completed jobs.

   b. 250 to 350 insertions of all types of revisions with accompanying removals.

3. Update and Test Deck filing

   a. 20 to 40 insertions in each of revisions to be processed.

Computer processing time. Processing time with both Program Schedule and Program Report is primarily a function of the input and output equipment speeds. Since this varies with different models, it must be estimated for a specific installation. There are two exceptions in Program Schedule. First, the read-through of the Library Deck is delayed by sorting and tabulating processes. Second, a calculation of the schedule, during which no input or output occurs, is accomplished at an approximate rate of 80 manhours per second. The provisions for by-passing the card punch routines greatly speed the output phase of Program Schedule in preparing a Tentative Shop Work Schedule.

VI. SUMMARY

The Autosked system is a composite of data preparation and distribution routines and computer programs. Its operation is based upon present organization of the scheduling function. Documents associated with Autosked

replace or supplement those presently in use. The only changes required in existing procedures are minor adjustments to the different data formats.

CHAPTER IV

THE LIBRARY DECK

As has been indicated, the Library Deck is the heart of the Autosked system. It is prepared under the supervision of the master scheduler and is maintained by him or his subordinates. It is anticipated that under Autosked maintenance of the Library Deck would be the primary activity of the master scheduler. In spite of automatic updating provisions which are a part of Autosked, much of the day-to-day posting to, and consultation of, the Library Deck must be on a manual basis.

Figure 5 in Chapter III showed the configuration of a ten-card set describing one job. The use of the ten cards per job format and the placement of the data fields thereon is largely the result of original arbitrary choices. Spacing between data fields, though admittedly wasteful of data space is provided for clarity in manual handling of the Library Deck. This is of primary importance if the Library Deck is to be the exclusive job information source in an emergency requiring reversion to manual scheduling. Further, the Autosked system calls for manual insertion of revision cards which requires ease in reading. The unused space on each Shop Card leaves room to insert additional data, a factor which was of concern in developing the system. The presence of a

separate card for each shop, including those without work on the job, facilitates servicing the Library Deck and was especially helpful in developing the computer programs.

A further description of the data contents of the Library Deck will give additional insight into the Autosked system and understanding of the variables considered. Unless otherwise indicated, all data is being developed at some stage in the present work input control process.

Numerical dates, referred to as Julian Dates, are used in the Library Deck because of their computational advantages. A Julian date consists of four digits. The first is the last digit of the year. That is, 4 for 1964, 5 for 1965, etc. The remaining three digits are the number of the day of the year. For example, 1 February is 033 and 29 August is 241 in a 365 day year.

I. MASTER CARD

Figure 11 depicts a Master Card and will be a helpful reference during the following discussion. Paragraph sideheads identify the data fields and the numbers in parenthesis following indicate the numbers of the card columns which contain the data field.

Control Number. (1-5) The first five columns of the Master Card are allowed for the control field. It is intended that this be the same number assigned by the Work Reception Unit when the work requirement first

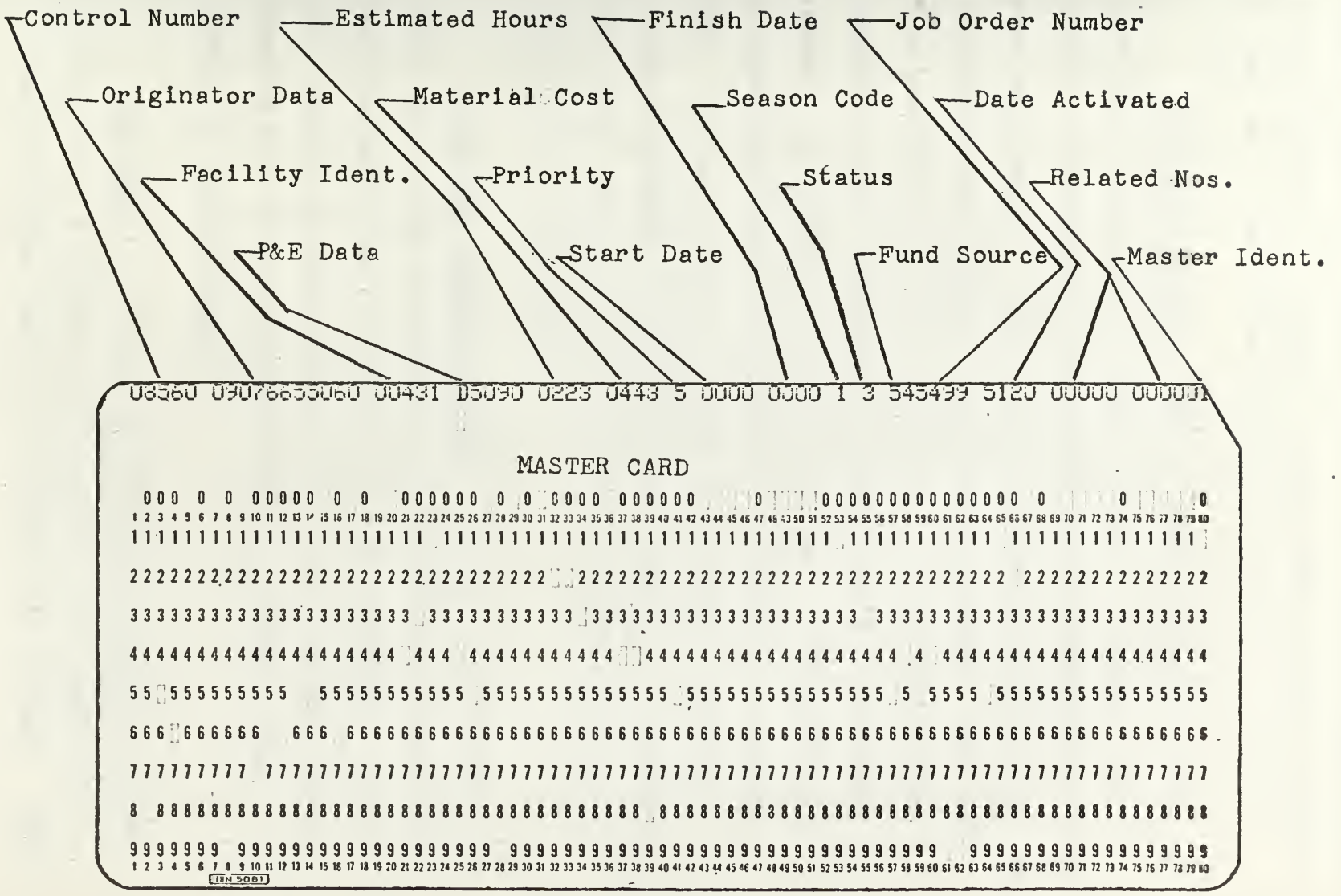


FIGURE 11

MASTER CARD



entered the Operations Division. It is the primary means of identifying the job and is the common element to each of the ten cards in the job set.

Originator Data. (7-17) The originator field is actually a composite of three fields. Columns 7 and 8 are for a two-digit code identifying the originator of the work requirement. The next five positions are allowed for the originator request identification number. The last four positions (14-17) contain the Julian date of the request. This information is used on the Job Listing report. In addition, the percentage of work generated by the Inspection Unit has been of interest to management. Though this project did not include writing a computer program to prepare such a report, it could be done very easily, provided Inspection generated work is identified in this field.

Facility Identification. (19-23) This field contains up to five alphanumeric characters to identify the facility upon which the work is to be performed. This will usually be the facility number but may be a word or abbreviation such as ROADS or GRNDS (grounds) when no particular number applies.

P&E Data. (25-29) This field contains a letter identifying the planner and estimator who handled the job and the Julian date he completed his estimate. This

data is not used in the present study but was included for manual reference purposes. Its inclusion also makes it possible to develop later a program for evaluating P&E performance.

Job Size. (31-39) The Estimated Hours field (31-34) and Material Cost field (36-39) contain information which is not used in the programs developed to date. However, this data may be useful for manual reference. Further, its inclusion makes possible a program to find total cost using only Master Card information. Estimated Hours is the total manhours for all shops. Material cost is in dollars.

Priority Information. (41-51) The Priority (41), Start Date (43-46), and Finish Date (48-51) fields provide information essential to the schedule decision-making process. The priority can be any number 1 through 9. If the job has a committed starting or completion date, this Julian date is entered in the Start Date and/or Finish Date fields. The assignment of a scale of priorities is a departure from current FIFO doctrine described in Chapter I. It is the opinion of the author that a scale of priorities recognizes what has always been actual practice and that FIFO is unsatisfactory as the sole basis for scheduling decisions. The following priority list was used for purposes of this study. It is intended

only as a possible list and is not advocated for universal adoption.

Priority Code	Description
1	Deferral would impair ability to perform mission
2	Deferral would constitute danger to personnel
3	Deferral would constitute danger to property
4	Deferral would interfere with performance of mission
5	Deferral would cause more costly work within one year
6	Deferral would cause level of maintenance to fall below standard
7	Deferral would detract from appearance of installation
8	Deferral is possible for one year without extra cost
9	Work is justified but not essential

Season Code. (53) This field contains a one-digit code indicating the seasonal nature of the job. It recognizes that some work can only be performed at certain times of the year at some locations. The following season codes were used in this study.

Season Code	Description
1	Work can be performed in any season

2	Work can be performed in spring, summer, or fall only
3	Work can be performed fall, winter, or spring only
4	Work can be performed spring of fall only
5	Work can be performed in winter only
6	Work can be performed in spring only
7	Work can be performed in summer only
8	Work can be performed in fall only

Job Status. (55) This field contains a one-digit code to describe the current status of the job. This is used in preparing the Job Listing through Program Report which causes the printing of the status description associated with the code. This code is used by Program Schedule and Program Report in sorting jobs. Further, it is used in the decision mechanisms of Program Schedule which place varying emphasis for scheduling upon each status code. The following status codes were used in this study.

Status Code	Description
1	Scheduled job
2	Previously scheduled but deferred for more urgent work
3	Activated, awaiting scheduling
4	Activated, held for material

5	In approved backlog awaiting activation
6	Pending approval of higher authority
7	Reimbursable work pending approval of requestor
8	Deferred pending job amendment
9	Deferred by maintenance officer

Fund Information. (57-62) This field consists of two parts, the Fund Source Code (57) and the Job Order Number (58-62). The fund source is, as previously mentioned, one of the primary scheduling parameters. The job order number is of little significance to this study. However, it has been included for illustrative purposes since it is a primary concern in the present cost and allotment accounting procedures. Provision for its inclusion here provides a bridge for translation of data between the accounting system based upon the job order number and the scheduling system keyed to the control number.

Date Activated. (64-67) This field contains the Julian date of activation of the job, the date the job order was approved. This date is the one used in applying the FIFO criteria in the scheduling payoff formula.

Related Control Number. (69-79) Two five position fields are provided for related control numbers. This is an aid to the scheduler and users of the Job Listing report

in identifying other work requirements which are related to, or included within, this given work requirement (control number). For example, in the job planning process work requirements that were originally separately identified may be combined into one job.

Master Card Identification. (80) Card column 80 always contains the digit "1" to identify it as a Master Card. Both Program Report and Program Schedule have provisions for stops if cards appear out of sequence.

II. JOB DESCRIPTION CARD

The Job Description Card contains only three data fields. The control number field (1-5) is the same as appears on all cards of the set. Column 7 always contains the letter "D" to identify the card as a Job Description Card in the sequence checking routines of the computer programs. The remainder of the card (9-80) is available for a short alphanumeric description of the work involved on the job.

III. SHOP CARDS

Each of the eight Shop Cards is prepared in the same format. If any particular field of data is not pertinent to a job, it is left blank or punched with zeros. Thus, a Shop Card for a work center which did not have work on the job would contain only the control

number and the work center number. Figure 12 depicts a Shop Card and identifies the data fields. Again, in the following discussion, paragraph sideheads name the data fields and the numbers following indicate the card columns containing the data.

Control Number. (1-5) Again, the control number appears in the same field as on other cards of the ten-card set.

Work Center. (7) Column 7 contains a single digit identifying the work center associated with the card.

Estimated Hours. (9-12) This field contains the number of hours of work estimated for the work center. This is maintained as a constant point of reference. Though a program was not developed as a part of this study, this data would be necessary in analyzing performance variance from estimates.

Estimated Workdays. (14-16) This field contains the estimated number of working days required for the shop to complete the job. This is, of course, a function of the crew size which is, in turn, a function of the nature of the work. This data is not presently well developed in job estimates. However, it can be obtained with little additional effort since crew size and job duration

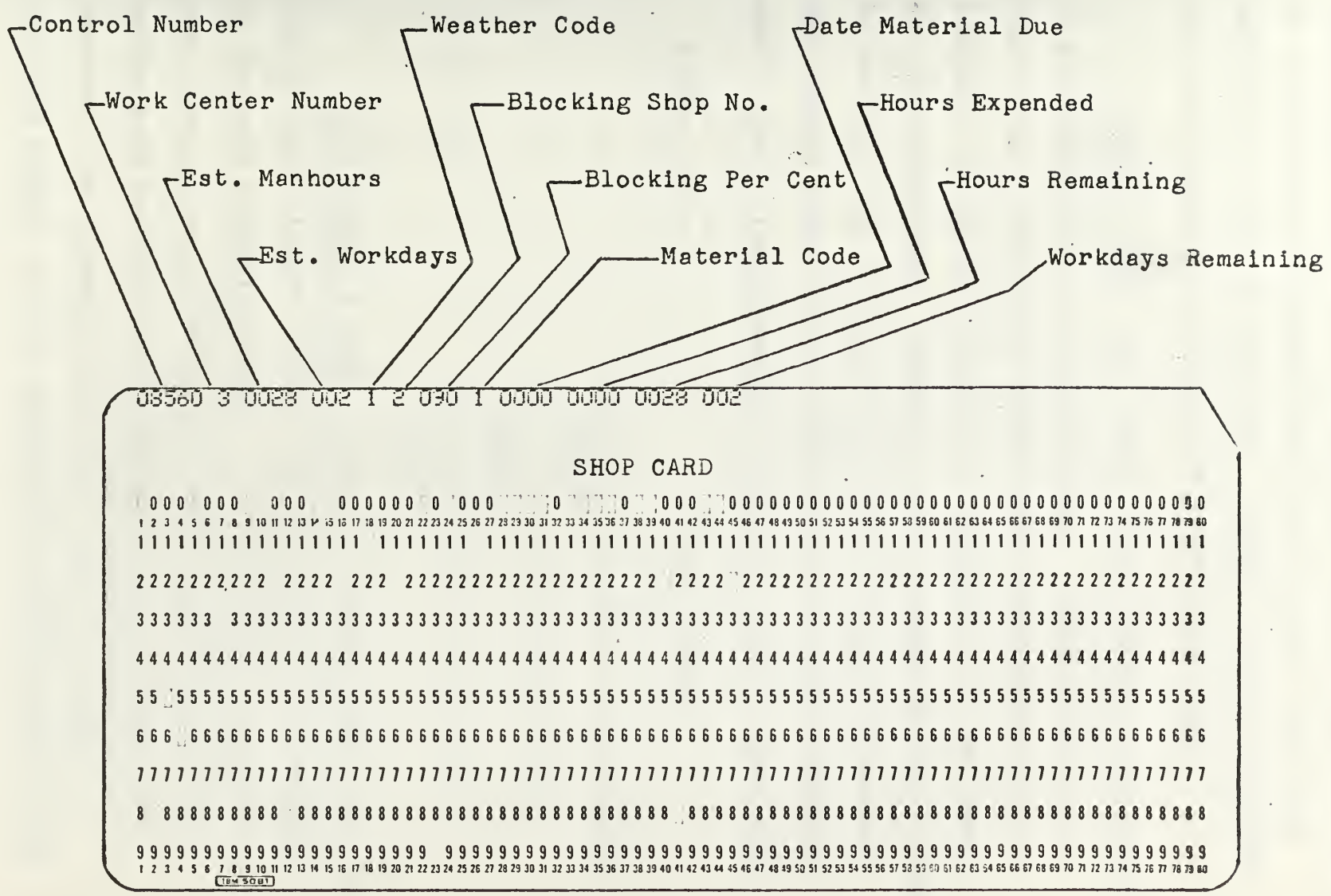


FIGURE 12

SHOP CARD



assumptions are a part of engineered performance standards. As in the case of the Estimated Hours field, this field serves as a point of reference. Again, it would be essential in a program to analyze performance variances.

Weather Code. (18) This field contains information on job sensitivity to precipitation. Though this consideration can occasionally assume major importance in the schedule, it was not feasible to include it in the normal decision mechanisms. However, this information was included on the Shop Card so that, when made necessary by weather, the Library Deck could be used manually to find alternate work. The following weather codes were used in this study.

Weather Code	Description
1	Work is insensitive to precipitation
2	Work can only be done in dry weather
3	Work can only be done in wet weather

Work sequence data. (20-24) The Blocking Shop (20) and Per Cent Blocked (22-24) fields contain data essential to the work scheduling logic. As indicated in Chapter I, sone jobs can be worked by all shops concurrently while others must be worked sequentially by all or some work centers. The Blocking Shop field holds the number of the work center, if any, which must complete some of its

work before the shop in question can commence work. Although several shops may have to complete work before the blocked shop can work, the shop causing the latest occurring, or most immediate, block is designated the blocking shop. The Per Cent Blocked field gives the percentage of its work the blocking shop must complete before the blocked shop can start. Referring to Figure 11 which is the Shop Card for Work Center #3, Work Center #2 blocks #3 from working until #2 has completed 90% of its total work. This data is not presently included in this form in current job estimates. However, work sequence must be considered by the P&E in developing the job plan. Therefore, identification of this data in the job estimates should present no additional burden. It should be noted that the P&E need specify only the individual blocks and their duration. The analysis of these blocks is performed by the computer and will be discussed in Chapter V.

Material data. (26-31) The Material Code (26) and Date Material Due (28-31) fields serve as reference points for manually consulted data. In addition, the material status is used in the scheduling logic to determine whether a work center could be scheduled for work or must be held up for material. It was originally contemplated that the date material is expected would be used as a refinement in Program Schedule. This was discarded, however, in view

of the general uncertainty associated with material delivery dates and the special inputs which would have been required. The following material status codes were used in this study. Their significance is discussed in Chapter V.

Material Code	Description
0	No material is required
1	Material is on hand
2	Requires material in local stock
3	Requires material through Marine Corps supply channels
4	Requires open purchase material

Hours Expended. (33-36) This field is blank or zero when the Shop Card is initially prepared. As work is completed and reported via Shop Schedule/Performance Cards, the manhours are added to this field through the operation of Program Schedule.

Hours Remaining. (38-41) This field contains the number of labor manhours remaining for the work center to complete its part of the job. When the Shop Card is prepared, this field will equal the Estimated Hours field. As the job progresses, this field is decreased through operation of Program Schedule based upon data reported on Shop Schedule/Performance Cards.

Workdays Remaining. (43-45) This field is initially equal to the Estimated Workdays field. Like the Hours Remaining field, it decreases as the job is performed. The combination of these two fields determines the rate at which labor can be applied to a job and are key factors in the scheduling logic.

This completes the description of data contained in the Library Deck. It will be noted that on all cards there is some data that is not used in the Autosked system as presently programmed. In addition, the Shop cards have a limited number of unused columns. Thus, even more data than that now carried could be accomodated.

IV. SHOP SCHEDULE/PERFORMANCE CARD

The Shop Schedule/Performance Card is not a part of the Library Deck. However, it should be noted that this card contains all the data fields of a Shop Card plus three additional fields. As has been explained, it is prepared during the execution of Program Schedule. A Shop Schedule/Performance Card was depicted in Figure 7 in Chapter III.

Hours Scheduled. (47-50) This field contains the number of manhours which the work center is to apply to the job during the week.

Hours Completed. (52-55) This field is blank when the card is delivered to the work center. At the end of the work week the number of manhours worked on the job is entered on the card by the shop supervisor. This is then punched into the field before the card becomes a part of the Update Deck.

Date. (57-73) This field carries the calendar date of the last working day of the week. This provides identification so that cards for different weeks will not be confused.

CHAPTER V

SCHEDULING LOGIC

To this point only general reference has been made to the work scheduling logic derived from this study and incorporated into Program Schedule. This chapter is devoted to a description of the salient points of Program Schedule and the rationale behind their treatment. Though Appendix A contains flow charts and detailed block diagrams, selected flow charts have been included here to clarify the points being didcussed. Figure 13 is a general flow diagram of the entire Program Schedule logic.

I. PRELIMINARY SCREENING

In arriving at the Shop Work Schedule (or Tentative Schedule) the full Library Deck is searched job by job. This, of itself, is an important aspect of an ADP oriented system. That is, all activated jobs are examined and considered for scheduling, a task which could be accomplished only with the most extensively manned manual systems.

The first order of business as each job is considered is to post revisions carried on the Update Tape. Also, on this first pass through the jobs it is possible to reject certain jobs from further consideration. These are:

1. Those whose committed starting date has not yet occurred and will not occur during the week being

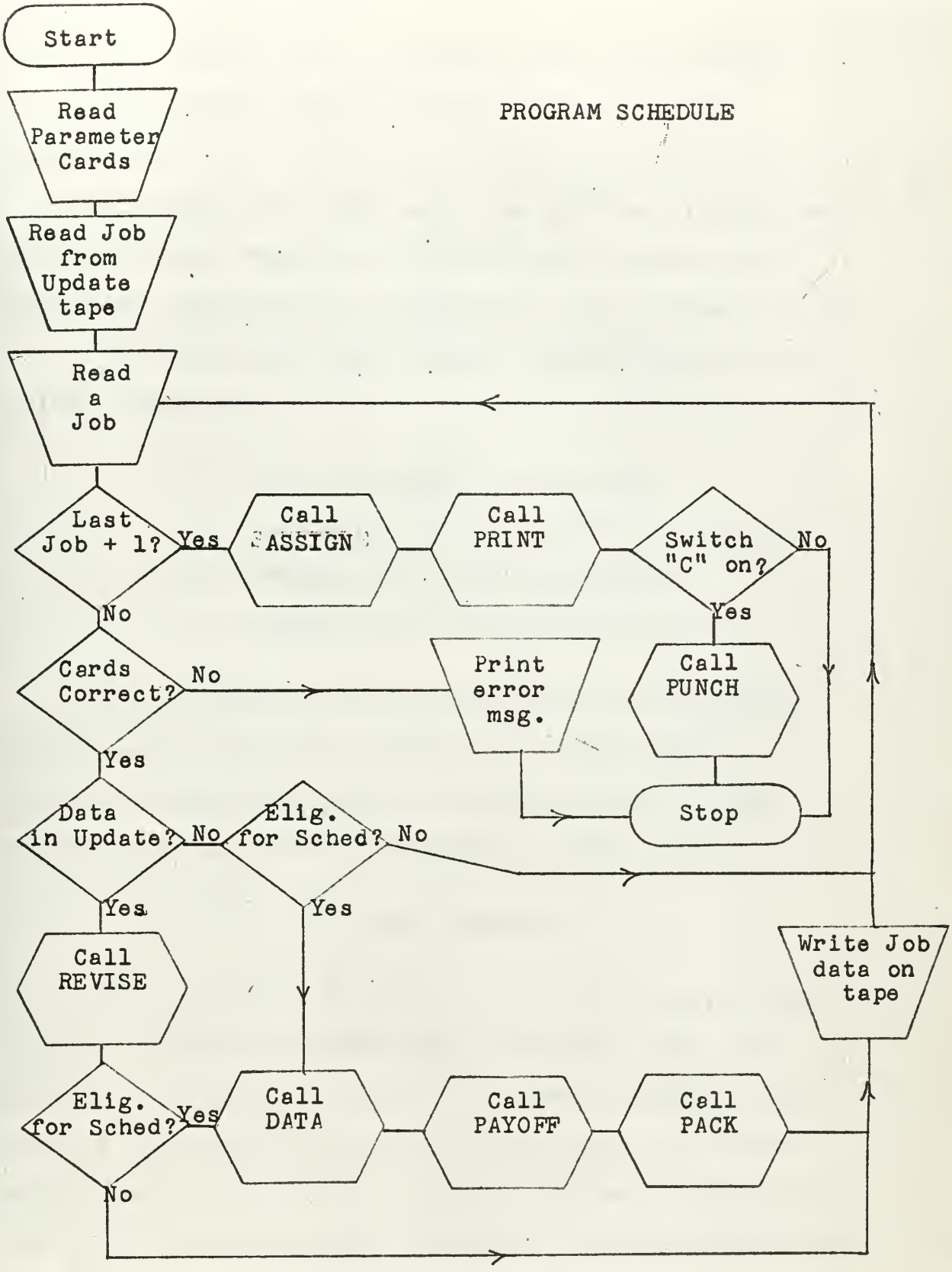


FIGURE 13

PROGRAM SCHEDULE FLOW CHART

scheduled. Specifically, these are jobs with a Julian start date greater than the Julian date of the last working date.

2. Those jobs that cannot be performed during the current season. These are the jobs with a season code other than those given as acceptable on the parameter card.

3. Those jobs whose current status precludes scheduling. These are:

a. Status 4--Held for material
b. Status 5--In backlog, not activated
c. Status 6 & 7--Pending approval
d. Status 8 & 9--Deferred for cause

Jobs by-passed for scheduling are not considered further unless they were involved in a data update. In this case certain job data is retained on tape so that revised cards can later be punched for the Library Deck.

II. WORK ANALYSIS

All jobs surviving the initial screening are considered eligible for scheduling. Therefore, they are analyzed to calculate the maximum number of manhours that could be performed by each work center during the forthcoming week. This is done in Subroutine Data depicted in Figure 14. The significant variables in the consideration are:

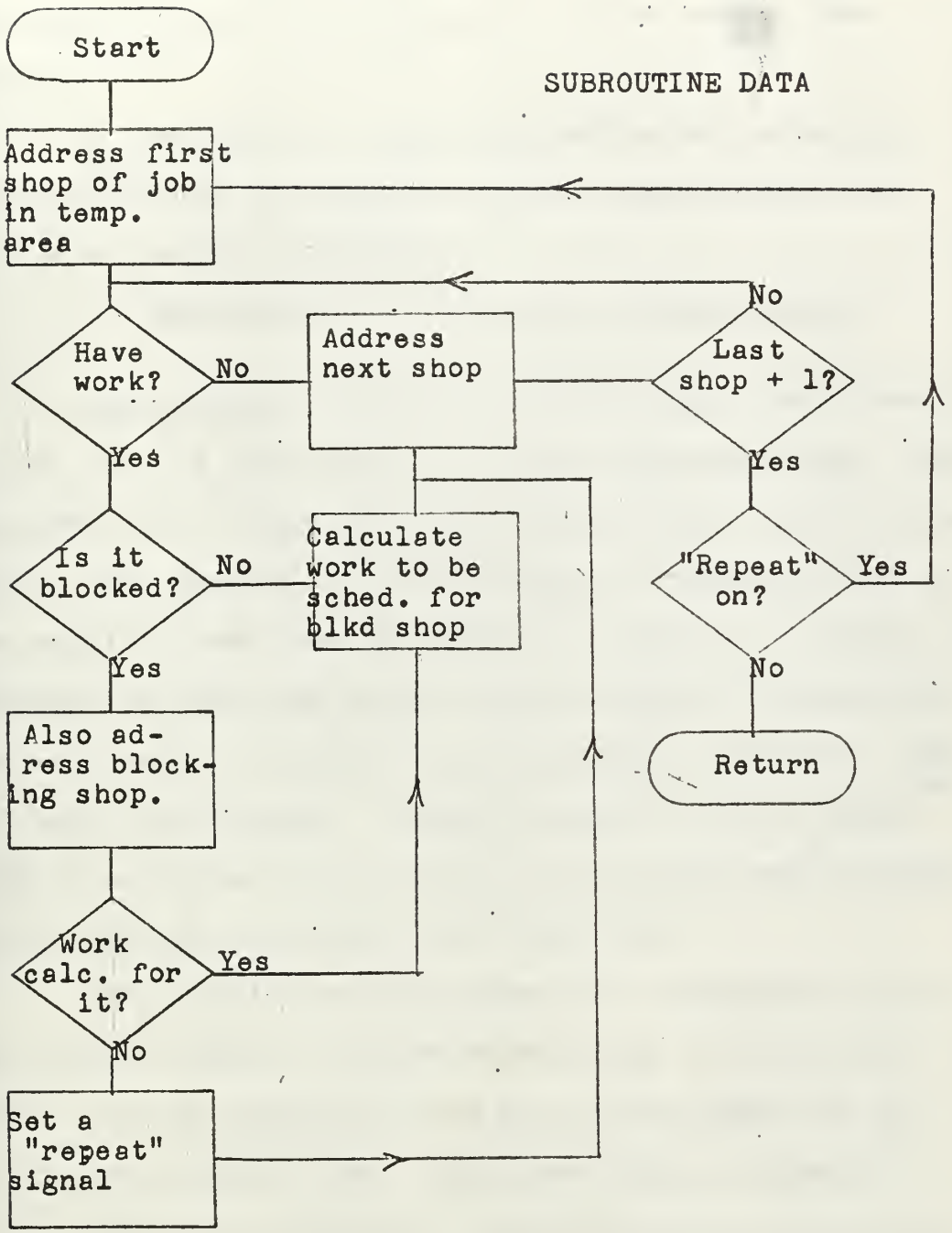


FIGURE 14

SUBROUTINE DATA FLOW CHART

1. The number of workdays in the week. This information is provided on one of the parameter card inputs.

2. The rate at which the job can be worked as calculated from the manhours of work remaining and the number of workdays remaining.

3. The presence of "blocks" by other shops.

The problems presented by the latter, the "blocks", are by far the most complex of these considerations. The procedure for coping with these blocks merits some explanation. The essence of the procedure is determination of the critical work path prevailing in the job. That is, the sequence in which the shops should commence work and the earliest point, in terms of working hours scheduled, that the shop can commence. Identification of the critical path is made possible by shop work sequence data provided by the P&E and included on each Shop Card.

Shops which are not blocked are considered first. The maximum number of hours scheduleable is calculated based upon the number of work days in the week and the calculated working rate. The entry point or number of work hours which must have elapsed during the week before the shop can start work is zero for these shops.

Shops which are blocked by one of the first group of shops are next considered. By applying the blocking

per cent to the number of hours estimated for the blocking shop, the point in the total job at which the blocked shop can start work is determined. This quantity is then used to determine whether or not the blocked shop can start during the week. If the blocked shop can be scheduled, the entry point and the number of available work days (to 0.1 day) are computed. This data is then used to calculate the maximum number of manhours which can be scheduled.

This process is repeated until the number of working days, the working rate, the maximum number of hours, and the entry point have been calculated for each shop. Of this data, the entry point and maximum scheduleable hours for each shop are of concern in the scheduling algorithm. Therefore, this information, together with a blank field for recording the number of hours actually scheduled, is stored in a table in core memory. The control number and fund source code are also placed with the other job data in the matrix.

III. PAYOFF CALCULATION

The next major task is determination of the sequence in which jobs should be brought into the work schedule. Some mention has already been made of the factors bearing upon this decision. These factors and their general impact are:

1. Job priority. The higher priority the job, the more important that it be scheduled promptly.

2. Job status. Other things being equal, jobs already on the schedule or previously started should be completed before new jobs are undertaken.

3. Deadline commitments. Every effort consistent with other priority considerations should be made to complete jobs by committed completion dates.

4. Age of job. All other factors being equal, the older jobs should be completed before new jobs. That is, first in, first out (FIFO).

A payoff formula was incorporated into Program Schedule to give selected weights to these factors in rank ordering the jobs. This formula is:

$$Y = \frac{A}{X_1} + \frac{B}{X_2} + \frac{C}{X_3} + DX_4 \quad \text{where,}$$

Y = A payoff number for the job

X_1 = The job priority code (1 to 9 possible)

X_2 = The job status code (1, 2, 3, and 5 are used)

X_3 = The number of days until the committed finish date

X_4 = The number of days since the job was activated

A, B, C, & D = Constants which are introduced on the parameter cards and whose value may be adjusted

Using this criteria, the jobs with the highest payoff are scheduled first. To facilitate this procedure,

jobs are entered into the core memory table in descending payoff number sequence. Thus, as the payoff for each job is determined, this table is rearranged as necessary to fit the job into its proper position.

Once a job has been entered in the table, basic job data is written on tape. This will be consulted later, and, if the job is placed on the schedule, will provide data for punching new cards for the Library Deck and Shop Schedule/Performance Cards.

SCHEDULING ALGORITHM

After all eligible jobs have been analyzed and entered into the core memory table, the actual work scheduling operation can begin. The scheduling algorithm accomplishes this one manhour at a time. Figure 15 is a flow chart of the process. The first work center of the highest payoff job (this is the first in the table) is addressed first and the following questions tested:

1. Do fund limitations permit scheduling any work on this job? On the first pass through the matrix this limitation is the minimum established for each fund source. If the answer is affirmative, the next test is made. If negative, the next job is addressed.

2. Can this shop accept work? If the answer is affirmative, the next test is made. If negative, the next shop is addressed.

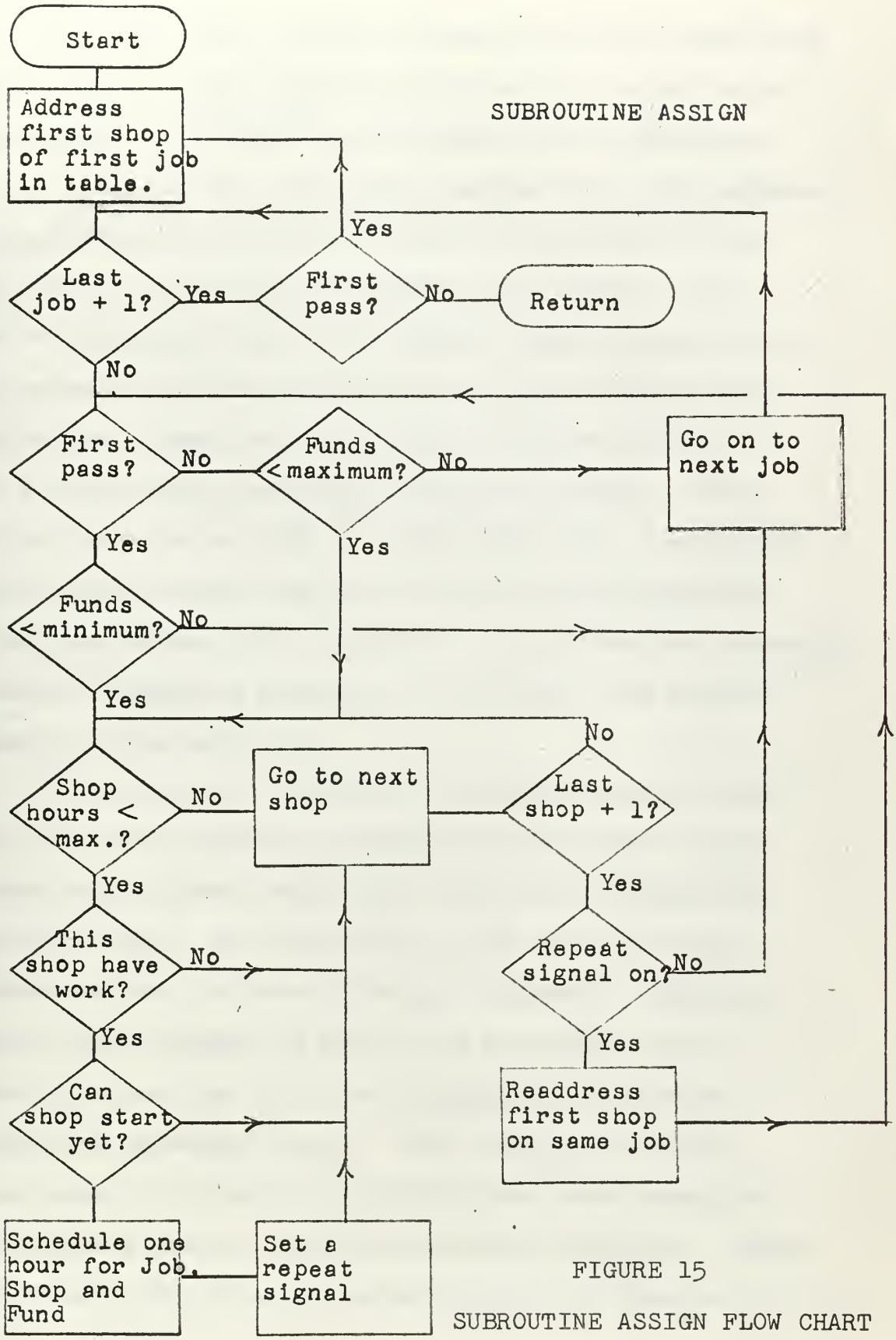


FIGURE 15

SUBROUTINE ASSIGN FLOW CHART

3. Does this shop have scheduleable work remaining on this job? If the answer is affirmative the next step is performed. If negative, the next shop is addressed.

If all of the foregoing questions have been answered affirmatively, one manhour of work is scheduled for the shop, the job, and the appropriate fund source. This involves adding to the work scheduled field in the table, and special registers established for each shop and each fund source. The next work center on the same job is then addressed and the above questions repeated. When the last work center (#8) has been addressed, the process returns to #1 on the same job if any work was scheduled on the pass-through just completed. If no work was scheduled (because of negative answers to the tests), the process proceeds to the next job.

This procedure continues through the matrix until sufficient work has been scheduled for each fund source to meet the minimums which were established through the parameter cards. The first job in the matrix is then readdressed and the same procedures followed. However, on this pass through the matrix the applicable fund limitations are the fund source maximums interjected through the parameter cards. Upon completion of this second pass, all possible work will have been scheduled and Program Schedule turns to the output routines. These outputs were described and examples given in Chapter III.

CHAPTER VI

REFINEMENTS AND CONCLUSIONS

Though the system developed herein is considered useable at most Marine Corps installations with certain adaptations, it must not be viewed as a finished product. It is a reasonable first approximation but will certainly require refinement. Some of the unsolved problems and potential refinements are discussed below.

I. SYSTEM TEST

Autosked was exercised in a test simulating six weeks of work scheduling. This test was based upon a Library Deck of 92 jobs representing a sampling of actual maintenance and repair job information. Job data was extracted from copies of job orders issued by the maintenance department of a large Marine Corps installation. Information not available on the job orders but desired in the Library Deck was simulated. Shop manpower availability and fund constraints were simulated for purposes of the test. Appendix C lists the parameters used in the test, reports processing details, and presents samples of the outputs generated.

It must be recognized that this test accomplished little more than a necessary program diagnosis and illustration of outputs. The only satisfactory test of Autosked

would be actual scheduling of actual work in parallel with the present manual procedure. Only in this way could the shortcomings and advantages be accurately measured. Such a test would confirm or eliminate the requirement for refinements suggested below.

II. REFINEMENTS

Job selection. No computer program has been developed for selecting work to be activated from the backlog of jobs. It was originally contemplated that such a program would be included in Autosked. However, realization of this objective was thwarted by excessive time required to obtain success with the programs presented. The author's lack of proficiency with the SPS programming was the primary cause of excessive time in program debugging.

Autosked is handicapped but not crippled without this backlog selection program. Such a program should present few problems (other than time). The required output would be a simple listing of the control numbers of the jobs recommended for activation. The decision criteria would be based upon constraints similar to those in Program Schedule. However, the decision should be simplified since it would be in terms of entire jobs rather than individual manhours. All data required for the decision is contained in the Library Deck or could

be introduced via the parameter cards.

System dimension limitations. It would be expected that the present system dimensions would become a problem in any large-scale scheduling operation. The 125 active job limit of Program Schedule is most easily dealt with. Since this limit is imposed by the capacity of a core memory table, and since jobs are stored in this table in descending order of payoff, a simple programming addition would provide that only the top 125 jobs be stored. Those not fitting into the top 125 would be "cast off". This pool of 125 jobs should be most adequate as a base from which the immediate schedule will be drawn.

It must be recognized that program additions would tend to reduce the present 125 capacity. However, in any reprogramming there is considerable potential for refining the present program to recapture core storage capacity.

The limitations are tighter with Program Report. A system with 125 activated jobs would probably be backed up by a pool of approved jobs awaiting activation much greater than the 115 which could be accomodated within the 240 limitation discussed in Chapter III. Fortunately, the situation can be rather easily relieved by using magnetic tape storage. Though Program Schedule requires two tape units in its execution, none are presently required by Program Report and are thus available for use as additional storage. The processing sequence of

Program Report lends itself to tape storage.

Servicing the Library Deck. As presently programmed, the Autosked system relies heavily upon manual placement of new and revised cards and removal of superceded cards in the Library Deck. Unquestionably, this reliance is a potential source of errors. Although the computer programs have provisions for detecting cards erroneously inserted in the Library Deck, the processing stops which result might become so numerous as to impair the value of the Autosked system. Each processing stop requires specific action to correct the error. If data for correction of the error is not available in the computer center or the time for correction cannot be spared, the job or jobs involved may have to be by-passed.

An alternative to manual insertion of revision cards would be the automatic generation of a new Library Deck weekly with the execution of Program Schedule. The constraint in this case is the availability and cost of the computer processing time to punch a new deck at the 250 card per minute rate of the IBM 1402 Card Read-Punch. Provided the processing time is available, this refinement of Autosked should be adopted at the outset.

Payoff formula. The payoff formula used in ranking jobs is untried. To serve its intended purpose, the payoff must be a reliable quantitative expression of the relative

worth of each job. If used for any purpose other than rank ordering jobs such as in a payoff maximizing criteria discussed under the next topic, the payoff must reflect the utility of working an hour on a particular job relative to the utility of working an hour on any other job.

The simple inverse and direct relationships may not adequately weight the payoff factors. Though some adjustment is possible through the choice of constants used, there is no provision for altering the degree of the payoff terms. In addition, it may be that other variables should be brought to bear in the payoff formula. A study aimed at identification of the proper variables and their multiple correlation with payoff is needed.

Scheduling algorithm. The two-pass scheduling algorithm of Program Schedule is elementary and provides only a solution. This may or may not be the best solution. Results of the limited system test suggest that the two-pass consideration may be inadequate for practical use.

Certain job configurations can cause failure to schedule minimum work for a fund source or work center though work is available. This is considered a serious defect in the case of the fund source since it is a failure to meet an established constraint. Failure to fully commit a work center may be justified if the only work available to the shop is from a fund source which has been fully committed to other shops on higher payoff work. Such a

case becomes a question of relative importance, a function of the payoff. Some refinements in this area have been programmed but were not ready for inclusion in this report.

At the outset of this project the author was desirous of applying a maximizing algorithm. This is part of the basis for use of a payoff. However, the scheduling system considered herein is more complex than those susceptible to the traditional linear programming techniques. In short, the author chose to emphasize the total system and was unable to adapt a maximizing criteria. From this discussion it can be seen that the refinement of the scheduling algorithm is, of itself, a suitable subject for extensive research. It is especially recommended for the mathematically inclined.

Multiple copies of outputs. The computer programs in Autosked produce a single copy of printed outputs. Additional copies can, of course, be obtained in a single printing by the use of multi-copy printer paper. However, this would not be adequate for the minimum of ten copies that would be required for an organization with eight shops. Where other means for rapid reproduction are not available, the programs could be modified to provide several executions of the output routines. This could not be done in the case of the Job Listing without resort to intermediate tape storage since this report is printed as the Library Deck is read.

Scope of the system. Autosked has been oriented toward scheduling specific maintenance jobs. As has been mentioned, not all of the labor in the work center is applied to this type of work. Relatively predictable amounts of the weekly labor total are applied to supervision, overhead, leave, emergency/service work, preventive maintenance, and fixed job assignments. It is entirely feasible that these could be included in the Autosked system by treating them as specific jobs and inserting appropriate data in the Library Deck. It would be necessary to assign payoff factors such that inclusion on the weekly Shop Work Schedule would be assured.

Override provision. As was suggested in the previous paragraph, inclusion on the Shop Work Schedule can be assured by artificial adjustment of the factors which are involved in the payoff computation. If such artificialities are objectionable, an easily accomplished refinement would be provision for scheduling selected jobs, including those of the type discussed in the previous paragraph, by a special priority code. This would cause an overriding of the usual payoff calculation.

Management reports. Computer outputs have been kept to the minimum considered necessary to operate the Autosked system. The range of information stored in the Library Deck makes possible a large variety of other reports to

management. Some of these such as P&E performance, percentage of work generated by inspection, and performance variance analysis have already been mentioned. The requirement for and format of these or other possible outputs is a local consideration.

III. CONCLUSION

This study has convinved the author that automated scheduling of real property maintenance work at Marine Corps installations is feasible and worthy of further development. The attractiveness of Autosked lies not in immediate cost savings but in its enhancement of one presently lagging aspect of the Maintenance Management Program. Specific benefits to be realized from a computer based system such as Autosked are:

1. An economical means of coping with the increasing constraints which must be considered in the work scheduling process. The equipment and personnel for such a system are presently available.

2. The automation of clerical tasks now requiring much of the master scheduler's time. This permits him to concentrate more on the longer range aspects of work planning.

3. Uniform application of predetermined and well defined scheduling criteria. This avoids much of the subjectivity of the present system.

4. All jobs are screened in arriving at any decision. This enhances work input control and minimizes the opportunity for administrative oversights.

5. Work backlog information is maintained current and readily available. The substantial effort required in manual preparation of backlog reports is eliminated.

The recommended course of further development would be a pilot project using Autosked as a point of departure. Initially, the pilot project should parallel an existing manual master scheduling operation.

Whatever the ultimate disposition of Autosked, its development has led the author to a special appreciation for the problems in application of ADP to the maintenance management system. This would seem capable of generalization to other efforts to automate management systems.

The most cogent result has been the conclusion that a manager must be sufficiently familiar with ADP hardware and software capabilities and limitations to recognize potential applications in systems under his control. A passing acquaintance is inadequate. While experts can be consulted, the problem must be well understood and defined before the call is issued if the time of the expert is to be spent profitably. The manager need not be a computer programmer, but he must be familiar with programming considerations to be realistic in his expectations and in his communication with the experts.

This conclusion carries a mandate to Marine Corps managers of administrative and, eventually, operational systems. While a team of ADP experts is being developed, this group cannot address itself adequately to the recognition of applications. A conscious effort is required to familiarize middle and top managers with ADP so that they can perform this function.

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APPENDIXES

APPENDIX A

PROGRAM SCHEDULE

I. General

This program, written in the SPS language, prepares a printed work schedule of jobs under cognizance of the Autosked system. It generates three types of punched cards which serve as work directives to the shops, revisions to the data library, and a source of data for preparing tentative schedules. This same program, by changing sense switch settings, can be used to prepare normal or tentative schedules. A magnetic tape containing updating information is a necessary input source. Details for its preparation are included herein. A second tape serves as a temporary file during execution of the program. A general discussion of program inputs, outputs, and operation are contained in the basic text.

II. Machine Requirements

A. Hardware. The basic requirement is an IBM 1401 data processing system. The processing unit must have a 16,000 character storage capacity. A read-punch, printer, and two tape units are required.

B. Special features. In addition to the 16,000 character storage, the following special features are used:

1. Multiply-divide
2. High, low, equal compare

3. Indexing

4. Store address register

5. Move record

6. Sense switches

C. Core storage. The program requires approximately 5400 positions of core storage. In addition, each job considered for scheduling and entered into the core storage table requires 83 positions. Thus, the maximum number of jobs which could be considered is 125.

III. Processing

A. Update Deck. The Update Deck is processed first. This requires a card-to-tape program for Tape Unit #1. If a schedule is to be prepared immediately, the tape may be left mounted on Unit #1. The Update Deck is not needed once this tape has been prepared and can be discarded.

B. Program Schedule.

1. The condensed program deck precedes the Library Deck in the read hopper.

2. The Update Tape is mounted on Unit #1 and a scratch tape on Unit #2.

3. Punch must be "On" and hopper loaded with Shop Schedule/Performance Cards unless punching is by-passed.

4. Sense Switch B is "On" if punched card outputs are desired and is "Off" if punch routines are to be by-passed.

5. Sense Switch C is "On" if normal Shop Work Schedule is desired and is "Off" when preparing a Tentative Schedule.

6. Stops occur if cards are detected out of sequence. A message giving the source of the error and restart procedures is printed.

7. Completion is signaled by a printed message.

IV. Card Deck Preparation

A. Update Deck. The Update Deck must be assembled in control number sequence. In addition, within a control number set, the cards must appear in the following sequence, if they are present, when preparing a normal schedule.

1. Master Card revisions (any number).

2. Shop Schedule/Performance Card for Work Center #1.

3. Revision cards for Work Center #1 (any number).

4. Shop Schedule/Performance Card for Work Center #2.

5. Revision cards for Work Center #2.

6. Same as above for all eight work centers.

Only special input cards, arranged in control number sequence, are used when preparing a tentative schedule.

B. Library Deck. The Library Deck and added parameter cards are assembled in the following sequence.

5. Sense Switch C is "On" if normal Shop Work Schedule is desired and is "Off" when preparing a Tentative Schedule.

6. Stops occur if cards are detected out of sequence. A message giving the source of the error and restart procedures is printed.

7. Completion is signaled by a printed message.

IV. Card Deck Preparation

A. Update Deck. The Update Deck must be assembled in control number sequence. In addition, within a control number set, the cards must appear in the following sequence, if they are present, when preparing a normal schedule.

1. Master Card revisions (any number).

2. Shop Schedule/Performance Card for Work Center #1.

3. Revision cards for Work Center #1 (any number).

4. Shop Schedule/Performance Card for Work Center #2.

5. Revision cards for Work Center #2.

6. Same as above for all eight work centers.

Only special input cards, arranged in control number sequence, are used when preparing a tentative schedule.

B. Library Deck. The Library Deck and added parameter cards are assembled in the following sequence.

1. Date Card. Gives the Julian date of the first and last working days of the week being scheduled, the number of working days in the week and the calendar date of the last day of the week. These are punched as follows:

Card Columns	Description
1	The last digit of the year associated with the first day of the week (e.g., 1965 is coded as 5)
2-4	The 3-digit Julian date of the first working day
5	The last digit of the year associated with the last working day of the week
6-8	The Julian date of the last working day
9	The number of workdays in the week
10-26	The calendar date of the last day of the week (e.g., 20 May 1965)

2. Season/Payoff Constant Card. This card carries information on which season codes can be scheduled. It also inputs the constants used in the calculation of job payoffs. The card is punched as follows:

Card Columns	Description
1-5	Up to 5 season codes which may be scheduled are entered beginning in Column 1
6-8	The constant to be used in computing the job priority contribution to job payoff
9-11	Same as above but for status
12-14	Same as above but for finish date
15-17	Same as above but for job age

3. Fund Minimum Card. Gives the minimum number of manhours to be scheduled for each of the eight possible fund sources. Data is punched as follows:

Card Columns	Description
1-4	Minimum manhours for Fund Source 1
5-8	Minimum manhours for Fund Source 2
9-32	Same as above with fields of 4 digits for each of 8 fund sources

4. Fund Maximum Card. Gives the maximum number of manhours to be scheduled for each of the eight possible fund sources. Data is punched as follows:

Card Columns	Description
1-4	Maximum manhours for Fund Source 1
5-8	Maximum manhours for Fund Source 2
9-32	Same as above with fields of 4 digits for each of 8 fund sources

5. Work Center Manpower Card. Gives the number of manhours to be scheduled for each of the eight work centers. Data is punched as follows:

Card Columns	Description
1-4	Manhours for Work Center #1
5-8	Manhours for Work Center #2
9-32	Same as above with fields of 4 digits for each of 8 work centers

6. The Library Deck in the sequence maintained.

7. A blank card to signal the end of the data.

V. Block Diagram and Flow Charts

The block diagram which follows depicts the program logic and also serves as a SPS program listing. The glossary preceding the diagram identifies the labels used. Flow charts of general program logic follow the block diagram.

Label	Definition
ASTER	An Asterisk
BLANK	Field of 4 blanks
CON___	A numerical constant
CONSNT	A reference point for the payoff constants
CONT__	A jump in the program
COUNT_	Counters for the number of jobs processed
DASHES	Two dashes indicating no work for the shop
DATA	The start of the routine for computing hours available for scheduling
DATE	The calendar date
DAYS	Number of workdays available for a particular job
ENTRY	Number of hours which must have been worked on a job during a given week before a particular shop can start work
ERNOT_	Alphanumeric error message
ERRSTP	Routine for stopping if an error is detected
FIN	Notation that the shop has finished work on a job
FNDMAX	The prescribed maximum manhours to be committed from a given fund source in a given week

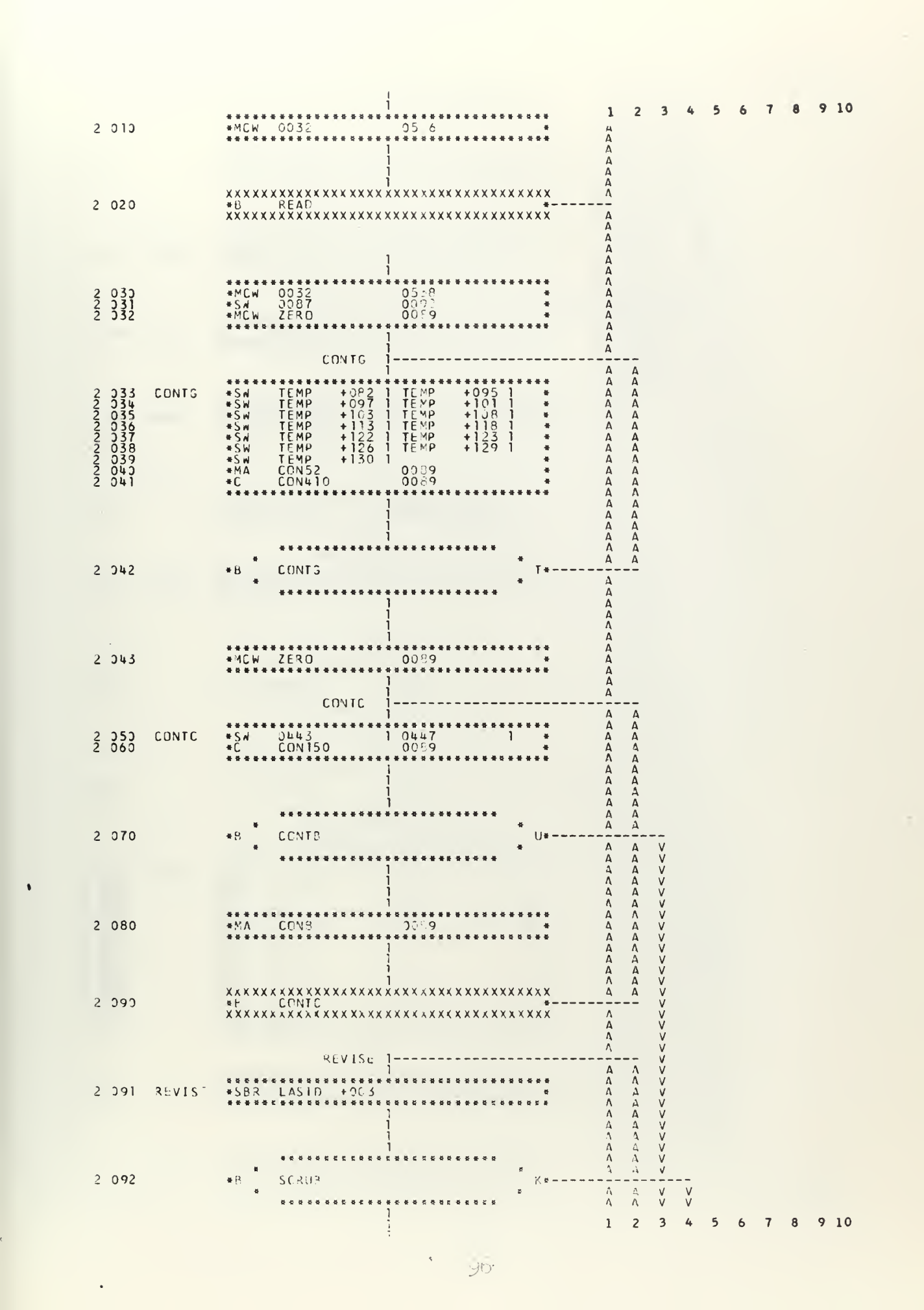
Label	Definition
FNDMIN	The prescribed minimum manhours to be committed from a given fund source in a given week
FNDREG	A register for accumulating the hours scheduled for each fund source
FOOT_	Alphanumeric footings for the schedule
FUND	A counter for recording the fund source under consideration
GRPMRK	A group mark with a word mark
HCOUNT	A counter for accumulating the number of hours scheduled for a job during the given week
HEAD_	Alphanumeric headings for the schedule
JOBEND	Words "Job Completed"
LIMIND	A signal to indicate which fund limitation applies
LINECT	Count of the number of lines of printing used
NEWJOB	Start point of the routine for processing one job
NOTE	Alphanumeric message of insufficient work
NOTIND	Signal to indicate NOTE is required
PACK	Routine for placing data in TABLE from TEMP
PAGECT	Count of the number of pages printed
PAYCLC	Routine for computing PAYOFF
PAYOFF	Total payoff for a job
PRINT	Starting point for the output routines
READ	A routine for reading cards and stacking
RECMRK	A record mark

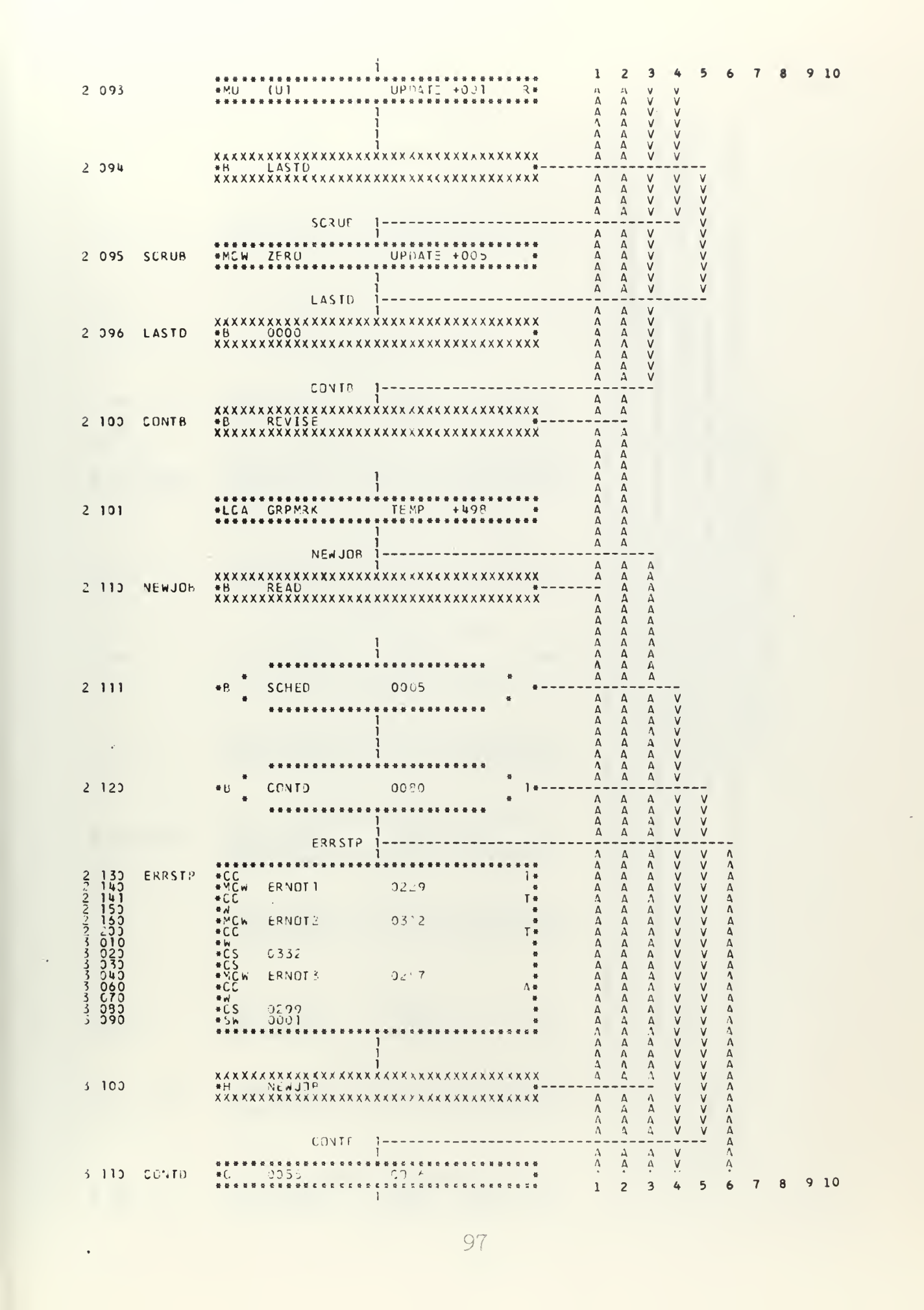
Label	Definition
REPEAT	A signal that at least one hour was scheduled on a pass through a job
REVISE	Routine for reading from Update Tape
SCHED	Start of the work commitment routines
SCRUB	Tape error routine
SEQ	An indicator of the sequence in which a job is worked
SETMRK	Routine for setting word marks
SHIFTA	Routine for shifting jobs within TABLE
TABLE	Reference point for core storage table of job data
TAPERR	Tape error routine
TEMP	Reference point for job data work area
TENT	The word "Tentative"
UPDATE	Reference point for updating data area
WAIT	Storage point for index contents
WCCT	Counter for work centers
WCMAX	The prescribed manhours to be scheduled for a given work center
WCREG	A register to accumulate hours scheduled for each work center
WRTAPE	Routine to write TEMP on tape #2
WORK_	Work area for computations
ZERO	A field of 4 zeros

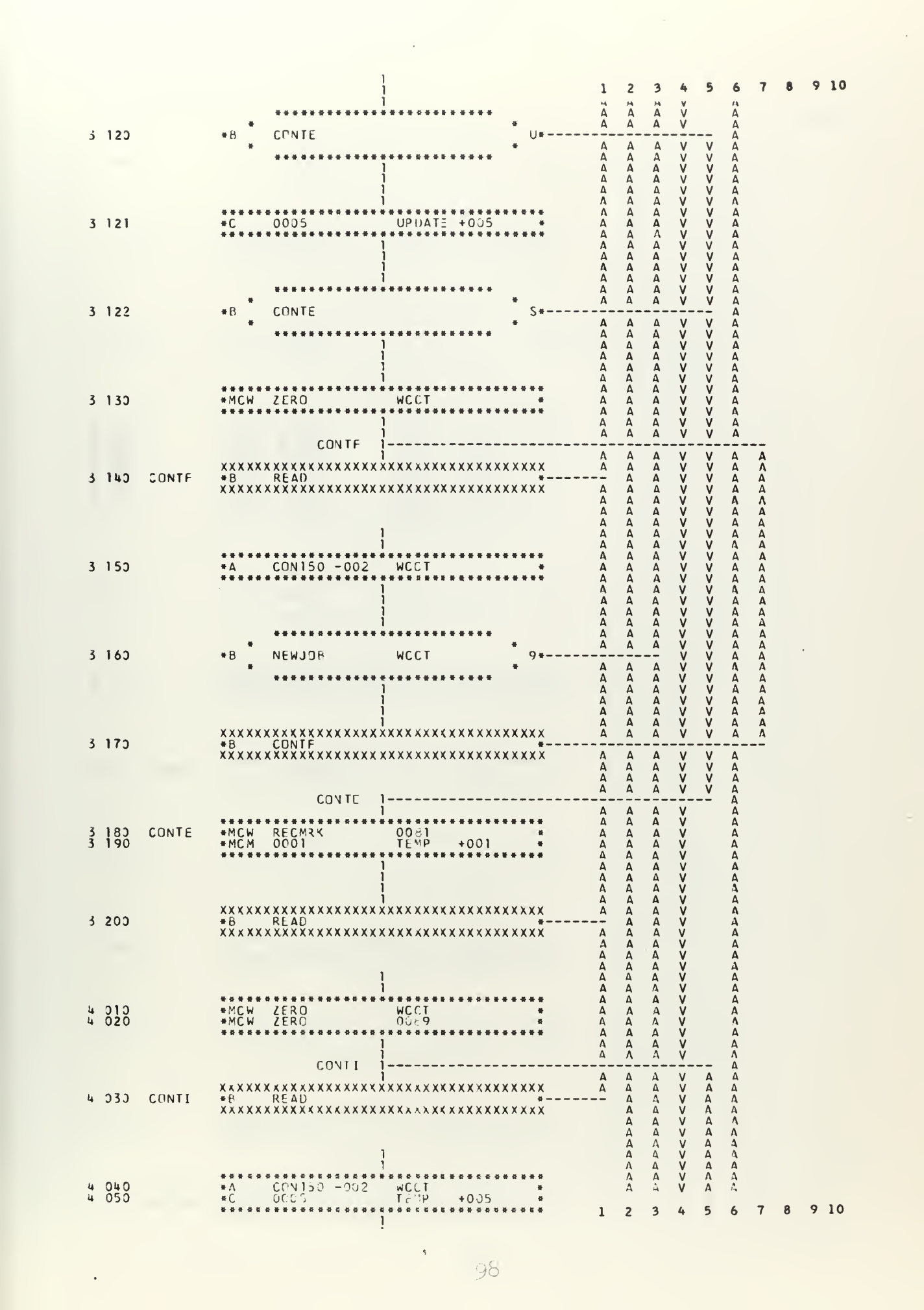
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PG LIN  LABEL   OP    A      ADJ XR   B      ADJ  XR D

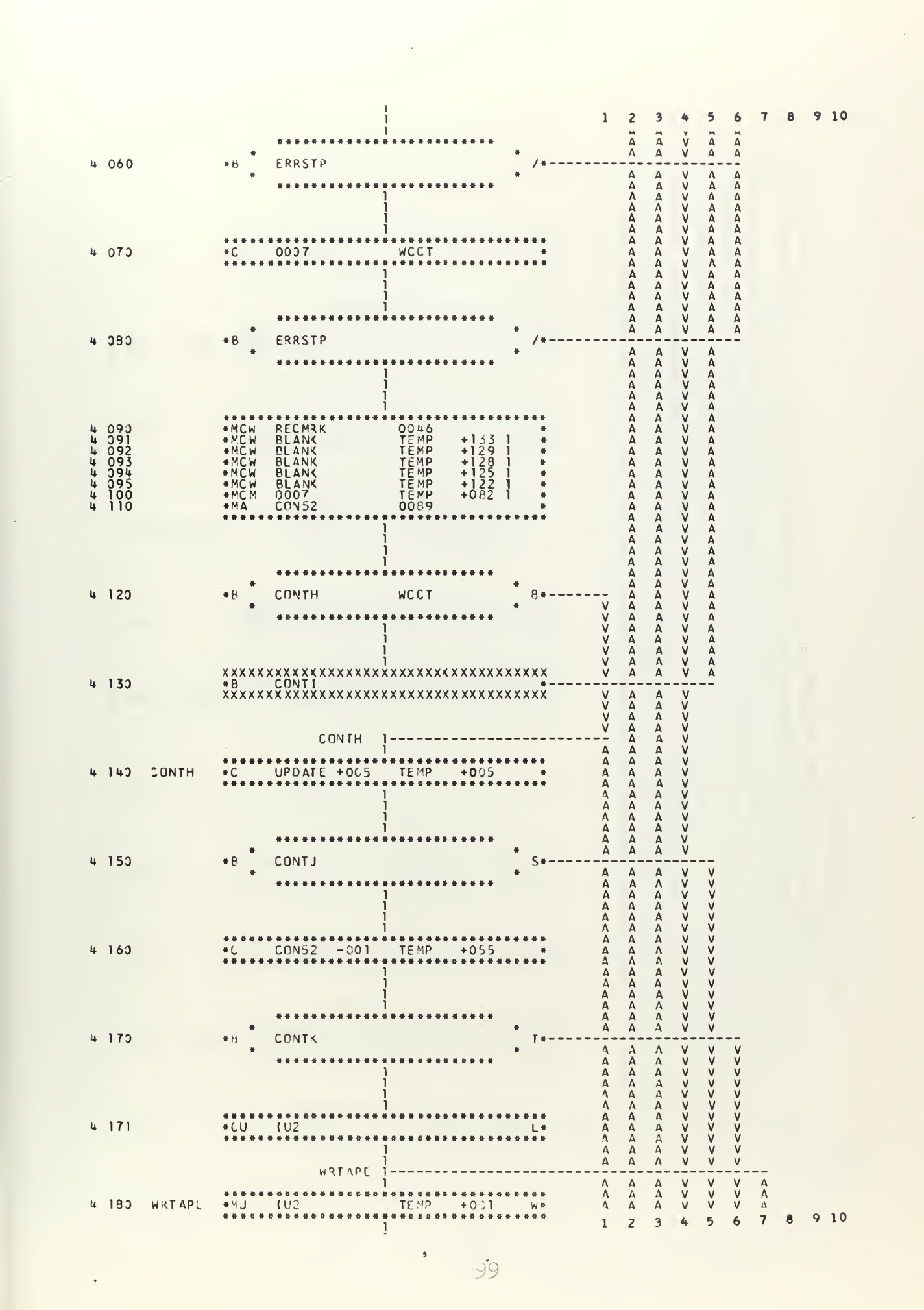
                ************************************
1 010           *CTL  66                           *
1 020           *ORG  1200                         *
                ************************************
                                  |
                                  |
                           READ   |-------------------------
                                  |                         A
                ************************************      A
1 030   READ    *SBR  LASTA  +003                  *      A
1 040           *R                                 *      A
1 050           *SS                               1*      A
                ************************************      A
                                  |                       A
                                  |                       A
                                  |                       A
                                  |                       A
                XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX    A
1 060   LASTA   *B    0000                          *      A
                XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX    A
                                                          A
                                                          A
                                  |                       A
                                  |                       A
                ************************************      A
1 061   START   *SW   0001                           *      A
                ************************************      A
                                  |                       A
                                  |                       A
                                  |                       A
                                  |                       A
                XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX    A
1 070           *B    READ                          *-------
                XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX    A
                                                          A
                                                          A
                                  |                       A
                                  |                       A
                ************************************      A
1 080           *LCA  0026          0425            *     A
1 090           *SW   0404          0408            *     A
1 100           *SW   0409          UPDATE +001     *     A
                ************************************      A
                                  |                       A
                                  |                       A
                                  |                       A
                                  |                       A
                XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX    A
1 110           *B    READ                          *-------
                XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX    A
                                                          A
                                                          A
                                  |                       A
                                  |                       A
                ************************************      A
1 120           *LCA  0017          0442            *     A
1 130           *SW   0427          0428            *     A
1 140           *SW   0429          0430            *     A
1 150           *SW   0431          0434            *     A
1 160           *SW   0437          0440            *     A
1 170           *SW   0097          TEMP    +053    *     A
1 171           *SW   TEMP   +041   TEMP    +043    *     A
1 172           *SW   TEMP   +048   TEMP    +055    *     A
1 173           *SW   TEMP   +058   TEMP    +064    *     A
1 174           *SW   TEMP   +069   TEMP    +075    *     A
1 175           *SW   TEMP   +001   TEMP    +057    *     A
                ************************************      A
                                  |                       A
                                  |                       A
                                  |                       A
                                  |                       A
                XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX    A
1 180           *B    READ                          *-------
                XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX    A
                                                          A
                                                          A
                                  |                       A
                                  |                       A
                ************************************      A
1 190           *LCA  0032          0474            *     A
                ************************************      A
                                  |                       A
                                  |                       A
                                  |                       A
                                  |                       A
                XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX    A
1 200           *B    READ                          *-------
                XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX    A
                                                          A

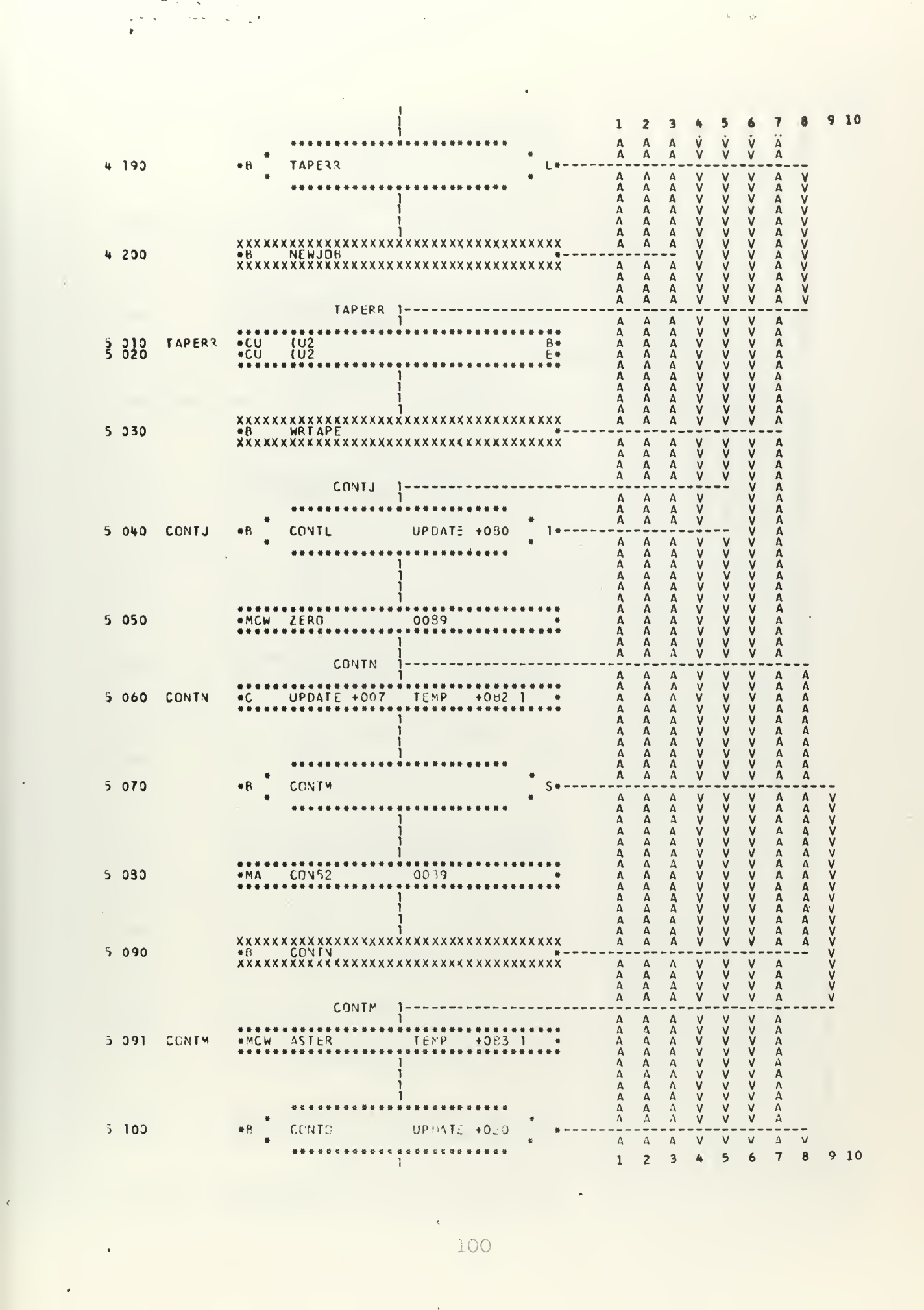
                                                          1  2  3  4  5  6  7  8  9 10
```

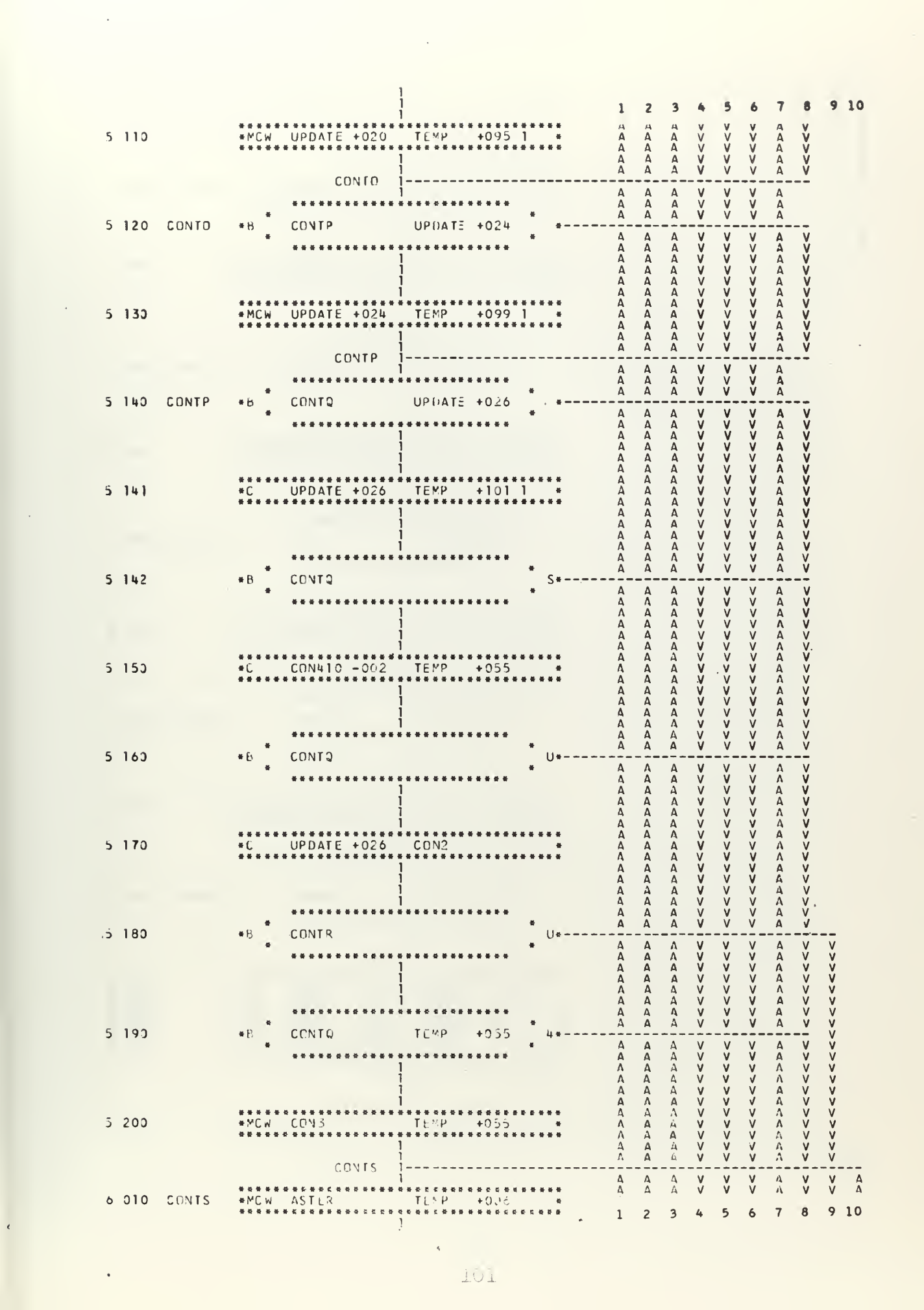

1 2 3 4 5 6 7 8 9 10
2 010 *MCW 0032 05 6
2 020 *B READ
2 030 *MCW 0032 05 8
2 031 *SW 0087 00
2 032 *MCW ZERO 0089
CONTG
2 033 CONTG *SW TEMP +082 TEMP +095
2 034 *SW TEMP +097 TEMP +101
2 035 *SW TEMP +103 TEMP +108
2 036 *SW TEMP +113 TEMP +118
2 037 *SW TEMP +122 TEMP +123
2 038 *SW TEMP +126 TEMP +129
2 039 *SW TEMP +130
2 040 *MA CON52 0089
2 041 *C CON410 0089
2 042 *B CONTS T
2 043 *MCW ZERO 0089
CONTC
2 050 CONTC *SW 0443 0447
2 060 *C CON150 0089
2 070 *B CONTB U
2 080 *MA CON8 0089
2 090 *B CONTC
REVISE
2 091 REVIS *SBR LASID +003
2 092 *B SCRUB K

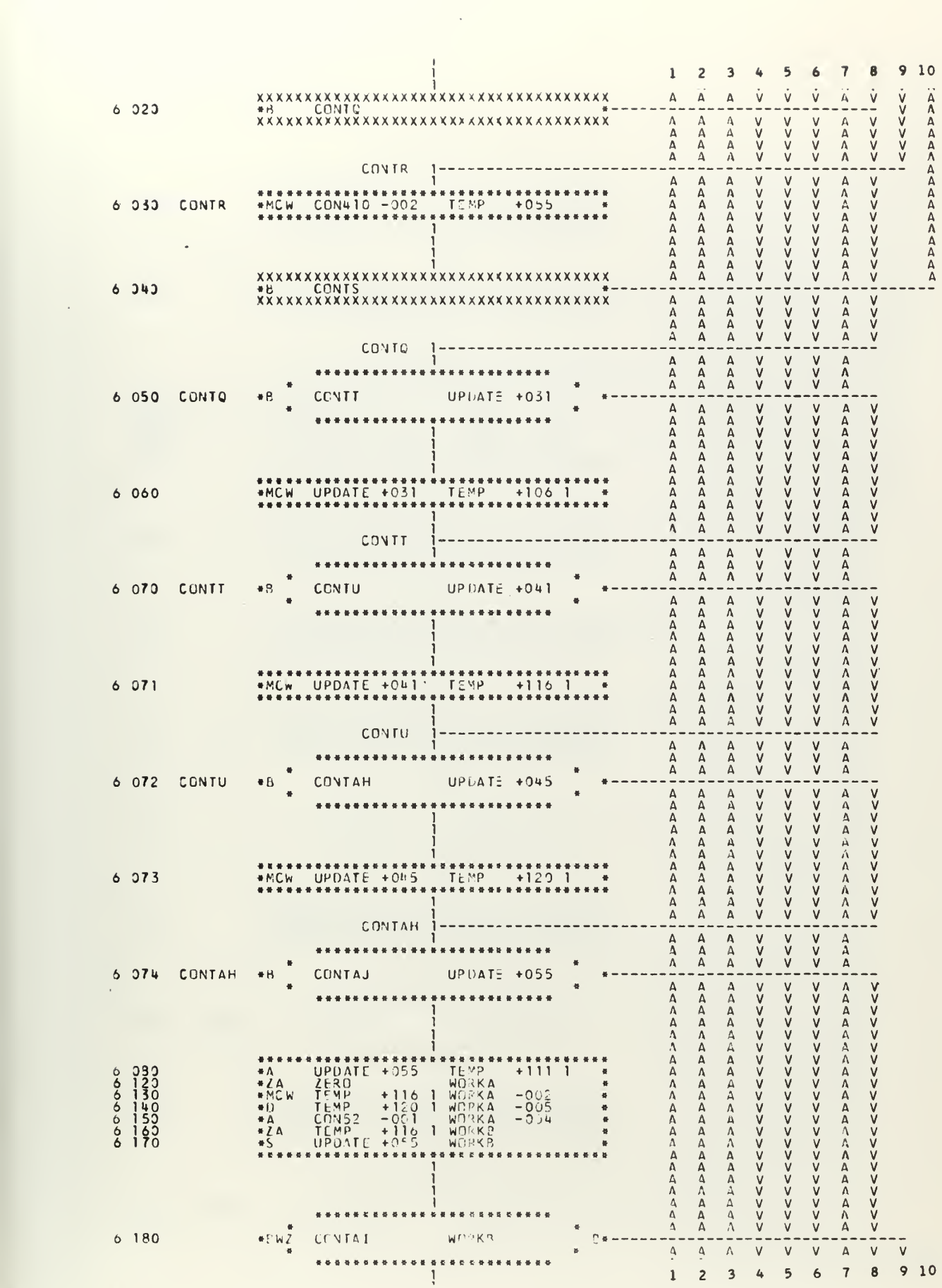

1 2 3 4 5 6 7 8 9 10
2 093 *MU (01 UPDATE +001 R*
2 094 *B LASTD
SCRUB
2 095 SCRUB *MCW ZERO UPDATE +005 *
LASTD
2 096 LASTD *B 0000 *
CONTB
2 100 CONTB *B REVISE
2 101 *LCA GRPMRK TEMP +498 *
NEWJOB
2 110 NEWJOB *B READ
2 111 *B SCHED 0005
2 120 *B CONTD 0080
ERRSTP
2 130 ERRSTP *CC
2 140 *MCW ERNOT1 0229 *
2 141 *CC T*
2 150 *W *
2 160 *MCW ERNOT2 0332 *
2 200 *CC T*
3 010 *W *
3 020 *CS 0332 *
3 030 *CS *
3 040 *MCW ERNOT3 0227 *
3 060 *CC A*
3 070 *W *
3 080 *CS 0299 *
3 090 *SW 0001 *
3 100 *H NEWJOB
CONTD
3 110 CONTD *C 0052 CO *
1 2 3 4 5 6 7 8 9 10

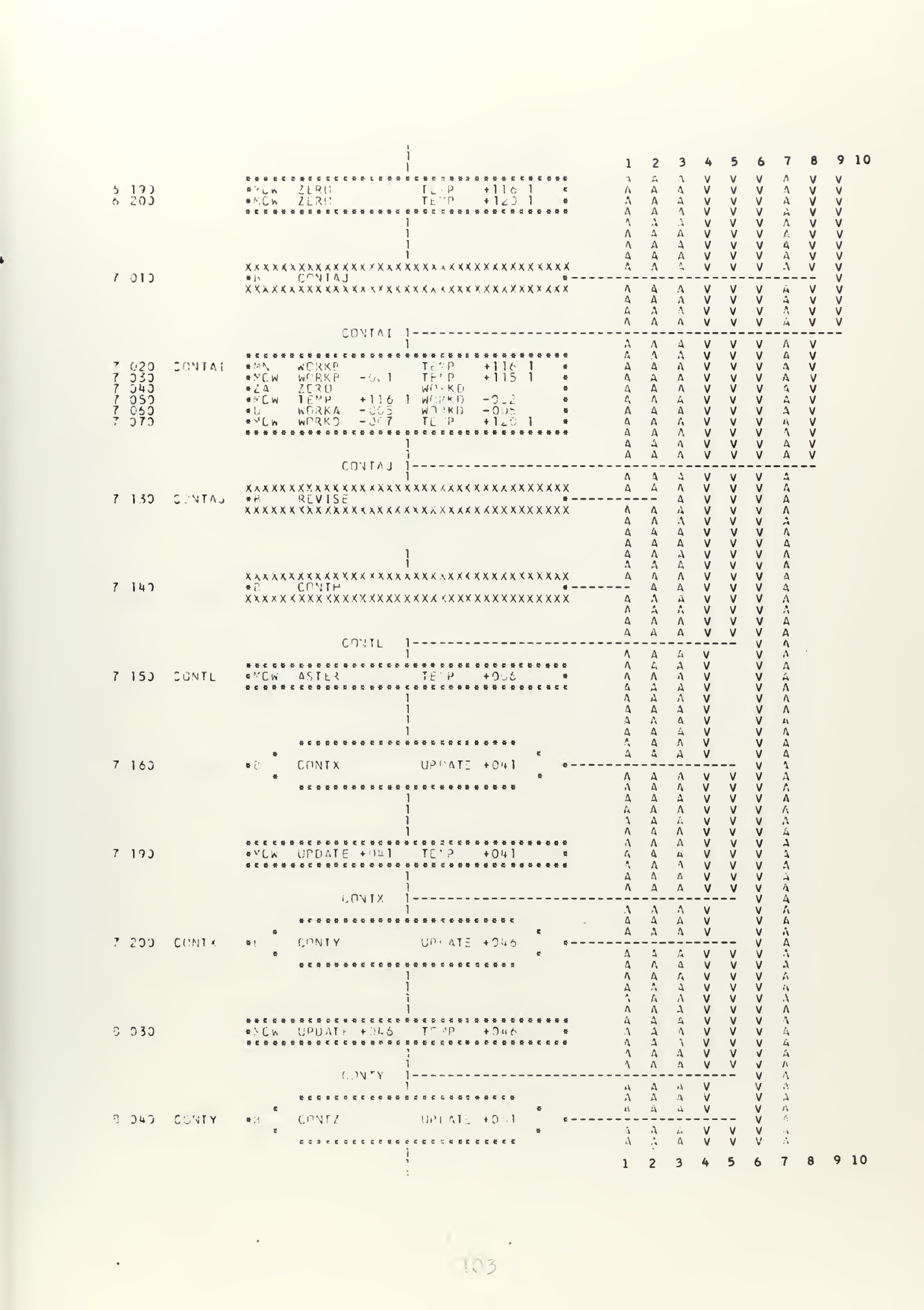

1 2 3 4 5 6 7 8 9 10
3 120 *B CONTE U*
3 121 *C 0005 UPDATE +005 *
3 122 *B CONTE S*
3 130 *MCW ZERO WCCT *
CONTF
3 140 CONTF *B READ *
3 150 *A CON150 -002 WCCT *
3 160 *B NEWJOB WCCT 9*
3 170 *B CONTF *
CONTE
3 180 CONTE *MCW RECMRK 0081 *
3 190 *MCM 0001 TEMP +001 *
3 200 *B READ *
4 010 *MCW ZERO WCCT *
4 020 *MCW ZERO 0089 *
CONTI
4 030 CONTI *B READ *
4 040 *A CON150 -002 WCCT *
4 050 *C 0005 TEMP +005 *
1 2 3 4 5 6 7 8 9 10

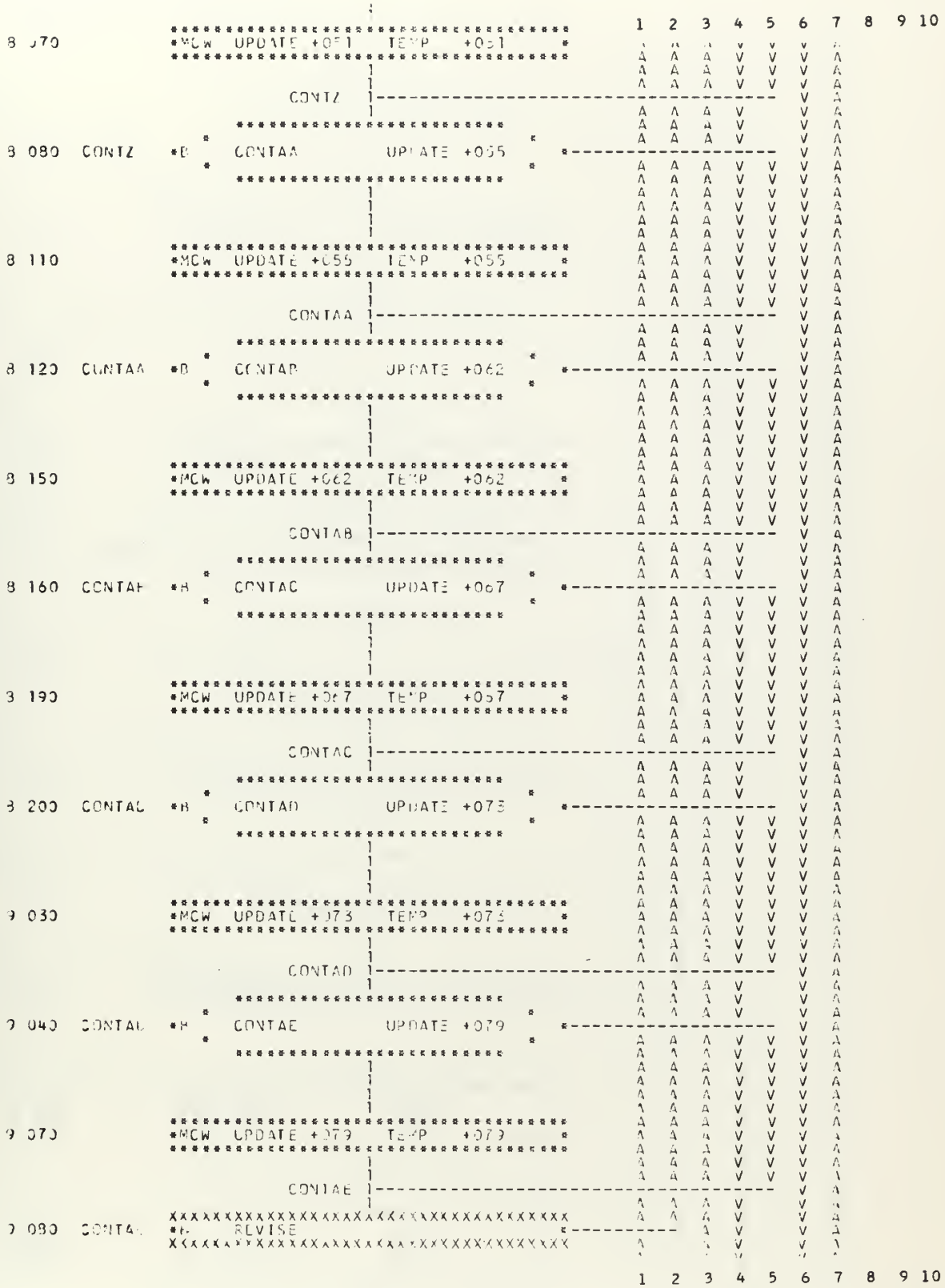

1 2 3 4 5 6 7 8 9 10
4 060 *B ERRSTP
4 070 *C 0007 WCCT
4 080 *B ERRSTP
4 090 *MCW RECMRK 0046
4 091 *MCW BLANK TEMP +133 1
4 092 *MCW BLANK TEMP +129 1
4 093 *MCW BLANK TEMP +128 1
4 094 *MCW BLANK TEMP +125 1
4 095 *MCW BLANK TEMP +122 1
4 100 *MCM 0007 TEMP +082 1
4 110 *MA CONS2 0089
4 120 *B CONTH WCCT 8
4 130 *B CONTI
CONTH
4 140 CONTH *C UPDATE +005 TEMP +005
4 150 *B CONTJ S
4 160 *C CONS2 -001 TEMP +055
4 170 *B CONTK T
4 171 *CU CU2 L*
WRTAPE
4 180 WRTAPE *MJ CU2 TEMP +001 W*

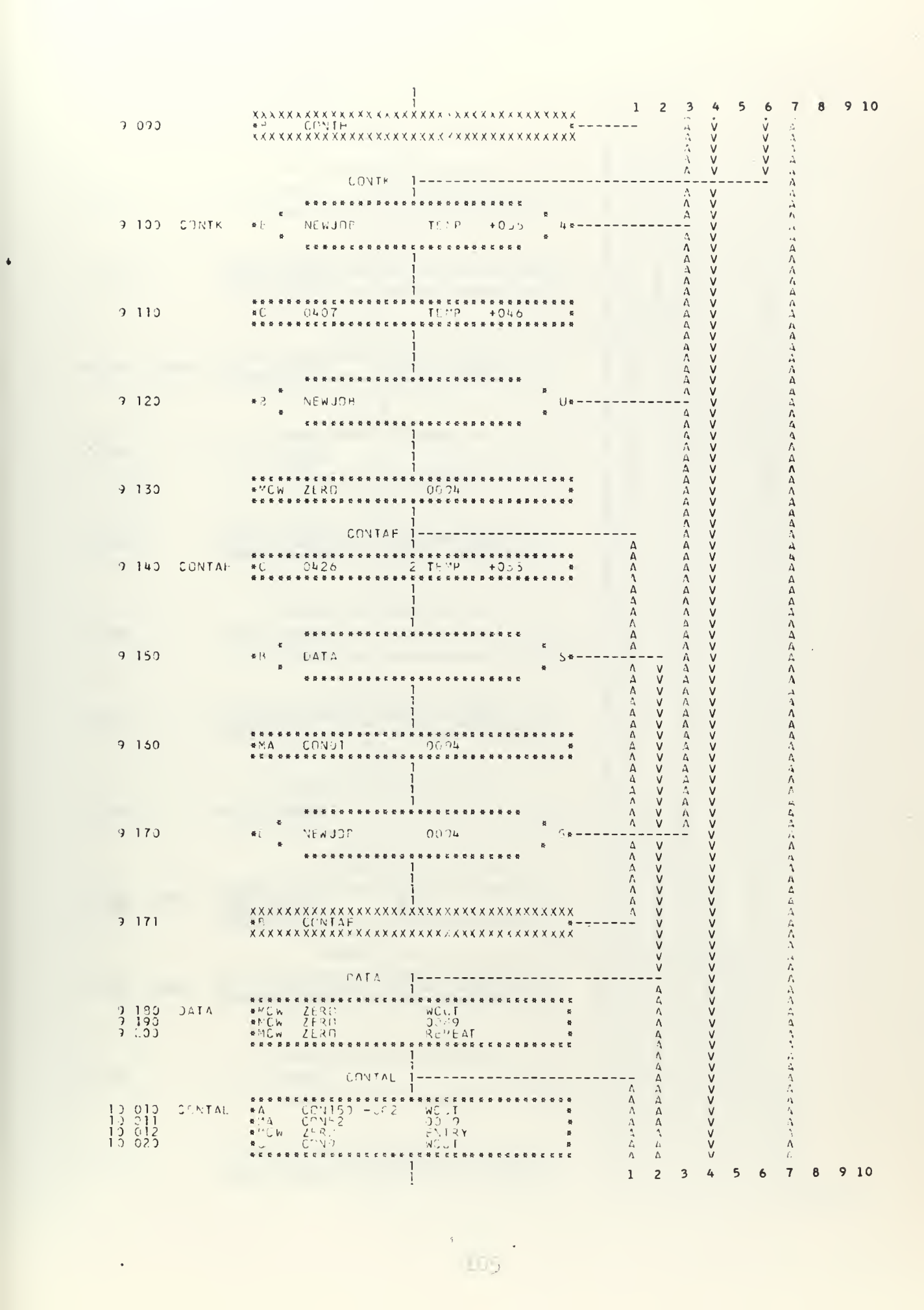

1 2 3 4 5 6 7 8 9 10
4 190 *B TAPERR L
4 200 *B NEWJOB
TAPERR
5 010 TAPERR *CU (U2 B
5 020 *CU (U2 E
5 030 *B WRTAPE
CONTJ
5 040 CONTJ *B CONTL UPDATE +080 1
5 050 *MCW ZERO 0089
CONTN
5 060 CONTN *C UPDATE +007 TEMP +082 1
5 070 *B CONTM S
5 080 *MA CON52 0039
5 090 *B CONTN
CONTM
5 091 CONTM *MCW ASTER TEMP +083 1
5 100 *B CONTO UPDATE +029
1 2 3 4 5 6 7 8 9 10

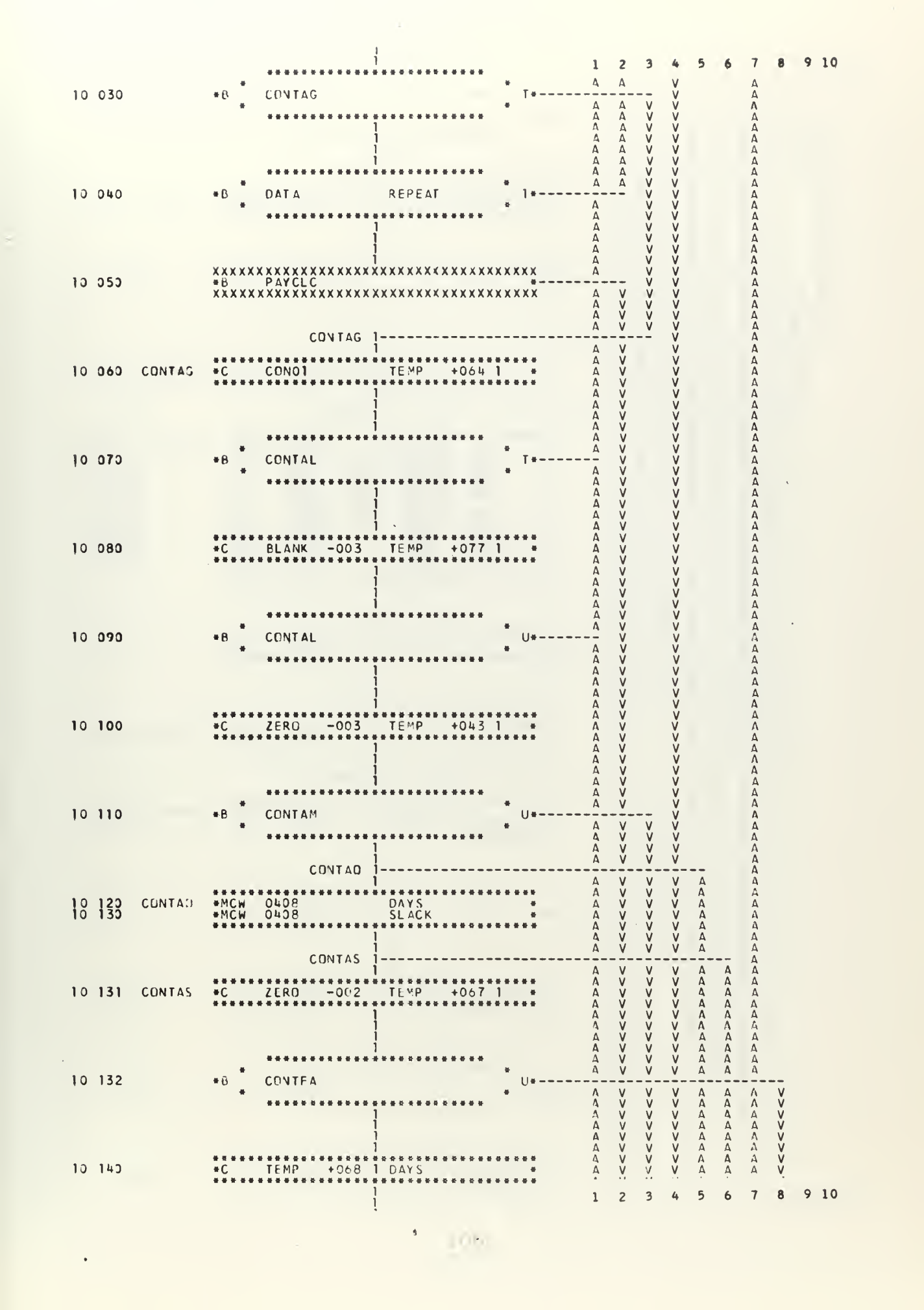

1 2 3 4 5 6 7 8 9 10
5 110 *MCW UPDATE +020 TEMP +095 1 *
CONTO
5 120 CONTO *B CONTP UPDATE +024 *
5 130 *MCW UPDATE +024 TEMP +099 1 *
CONTP
5 140 CONTP *B CONTQ UPDATE +026 *
5 141 *C UPDATE +026 TEMP +101 1 *
5 142 *B CONTQ S*
5 150 *C CON410 -002 TEMP +055 *
5 160 *B CONTQ U*
5 170 *C UPDATE +026 CON2 *
5 180 *B CONTR U*
5 190 *B CONTQ TEMP +055 4*
5 200 *MCW CON3 TEMP +055 *
CONTS
6 010 CONTS *MCW ASTER TEMP +000 *
1 2 3 4 5 6 7 8 9 10

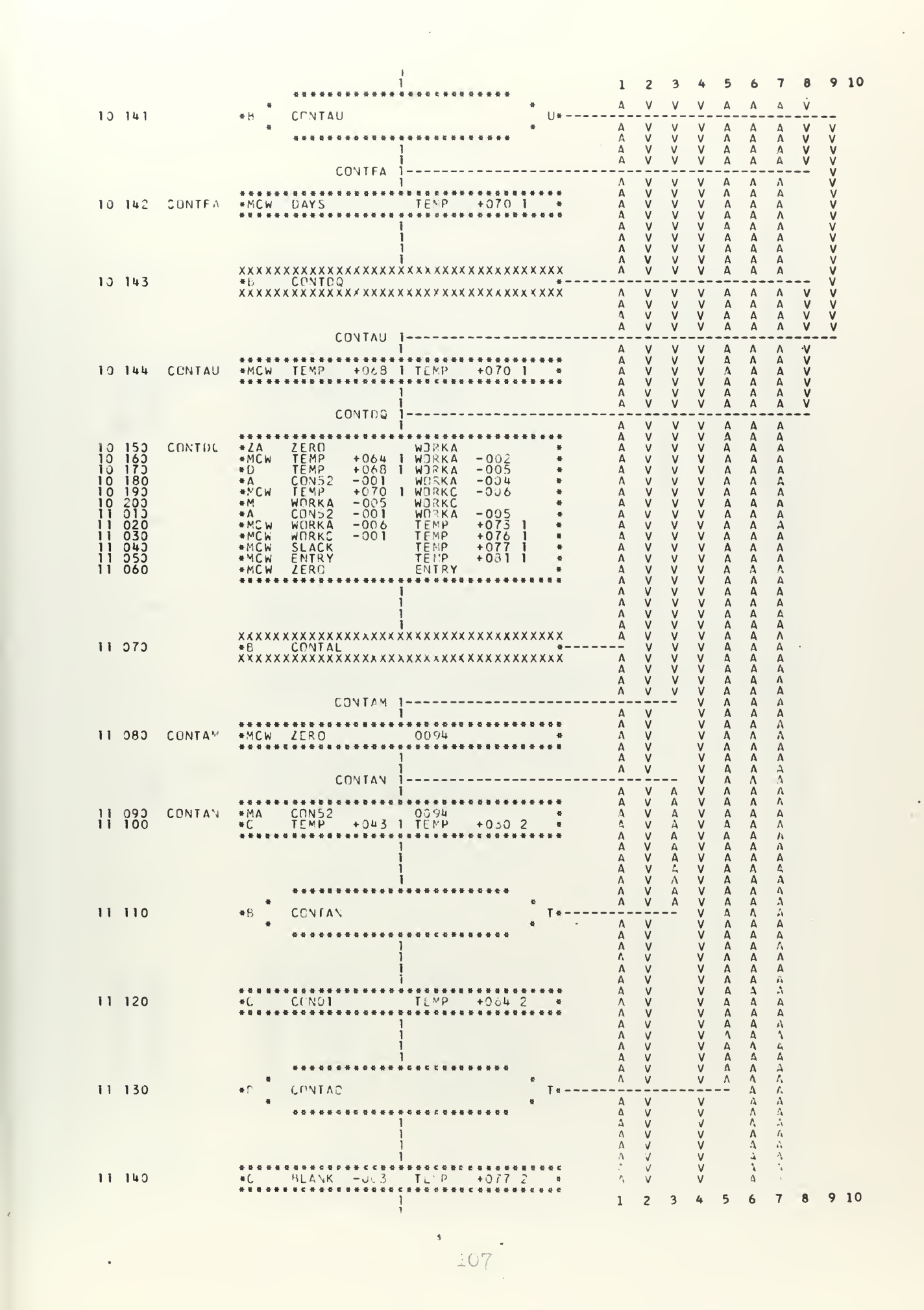

1 2 3 4 5 6 7 8 9 10
6 020 *B CONTQ
CONTR
6 030 CONTR *MCW CON410 -002 TEMP +055
6 040 *B CONTS
CONTQ
6 050 CONTQ *B CONTT UPDATE +031
6 060 *MCW UPDATE +031 TEMP +106 1
CONTT
6 070 CONTT *B CONTU UPDATE +041
6 071 *MCW UPDATE +041 TEMP +116 1
CONTU
6 072 CONTU *B CONTAH UPDATE +045
6 073 *MCW UPDATE +045 TEMP +120 1
CONTAH
6 074 CONTAH *B CONTAJ UPDATE +055
6 080 *A UPDATE +055 TEMP +111 1
6 120 *ZA ZERO WORKA
6 130 *MCW TEMP +116 1 WORKA -002
6 140 *D TEMP +120 1 WORKA -005
6 150 *A CON52 -001 WORKA -004
6 160 *ZA TEMP +116 1 WORKB
6 170 *S UPDATE +055 WORKB
6 180 *PWZ CONTAI WORKB
1 2 3 4 5 6 7 8 9 10

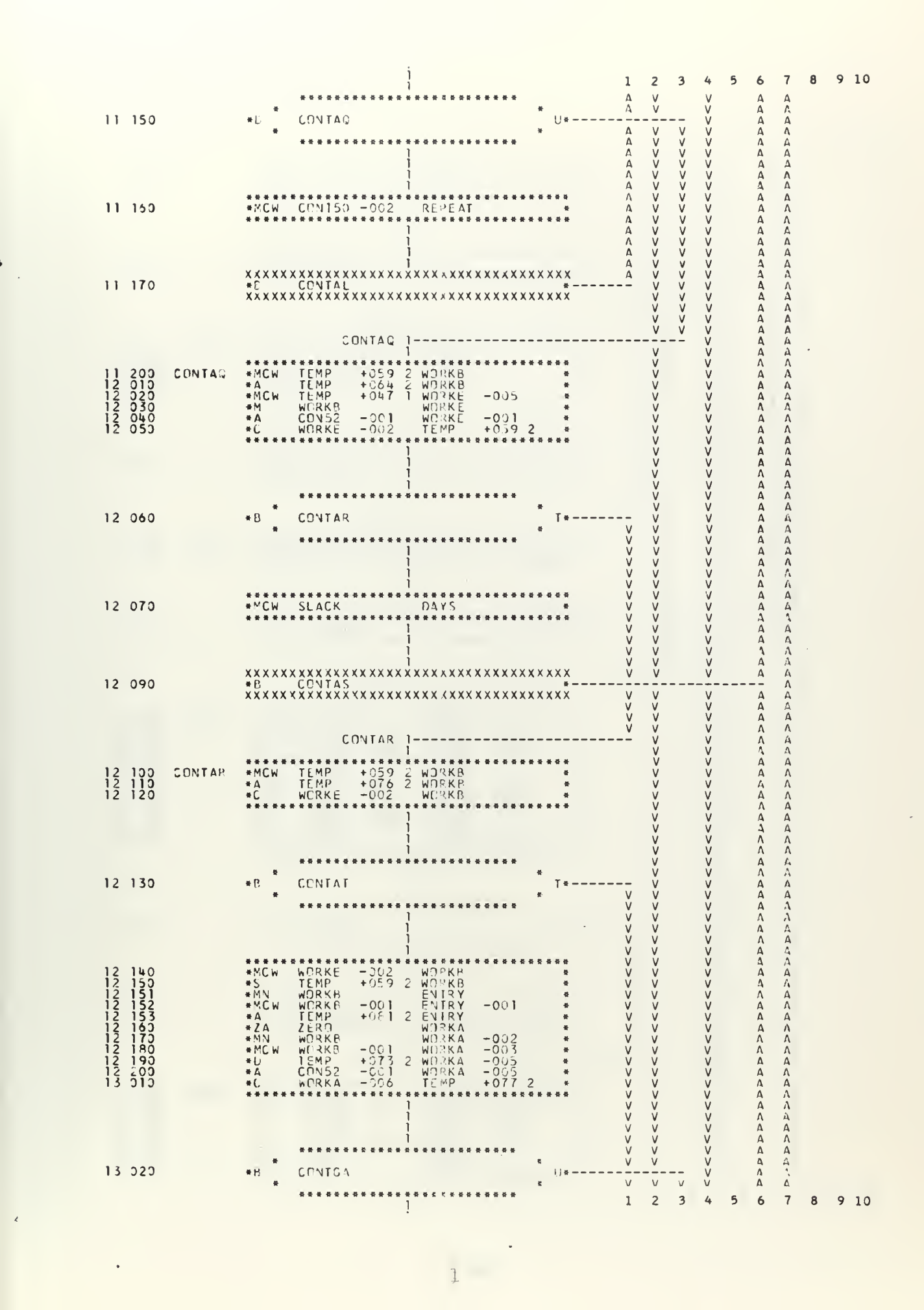

1 2 3 4 5 6 7 8 9 10
5 190 *MCW ZERO TEMP +116 1 *
6 200 *MCW ZERO TEMP +123 1 *
7 010 *B CONTAJ
CONTAI
7 020 CONTAI *MA WORKP TEMP +116 1 *
7 030 *MCW WORKP -001 TEMP +115 1 *
7 040 *ZA ZERO WORKD *
7 050 *MCW TEMP +116 1 WORKD -002 *
7 060 *B WORKA -005 WORKD -005 *
7 070 *MCW WORKD -007 TEMP +120 1 *
CONTAJ
7 130 CONTAJ *B REVISE
7 140 *B CONTH
CONTL
7 150 CONTL *MCW ASTER TEMP +046 *
7 160 *B CONTX UPDATE +041 *
7 190 *MCW UPDATE +041 TEMP +041 *
CONTX
7 200 CONTX *B CONTY UPDATE +046 *
8 030 *MCW UPDATE +046 TEMP +046 *
CONTY
8 040 CONTY *B CONTZ UPDATE +041 *

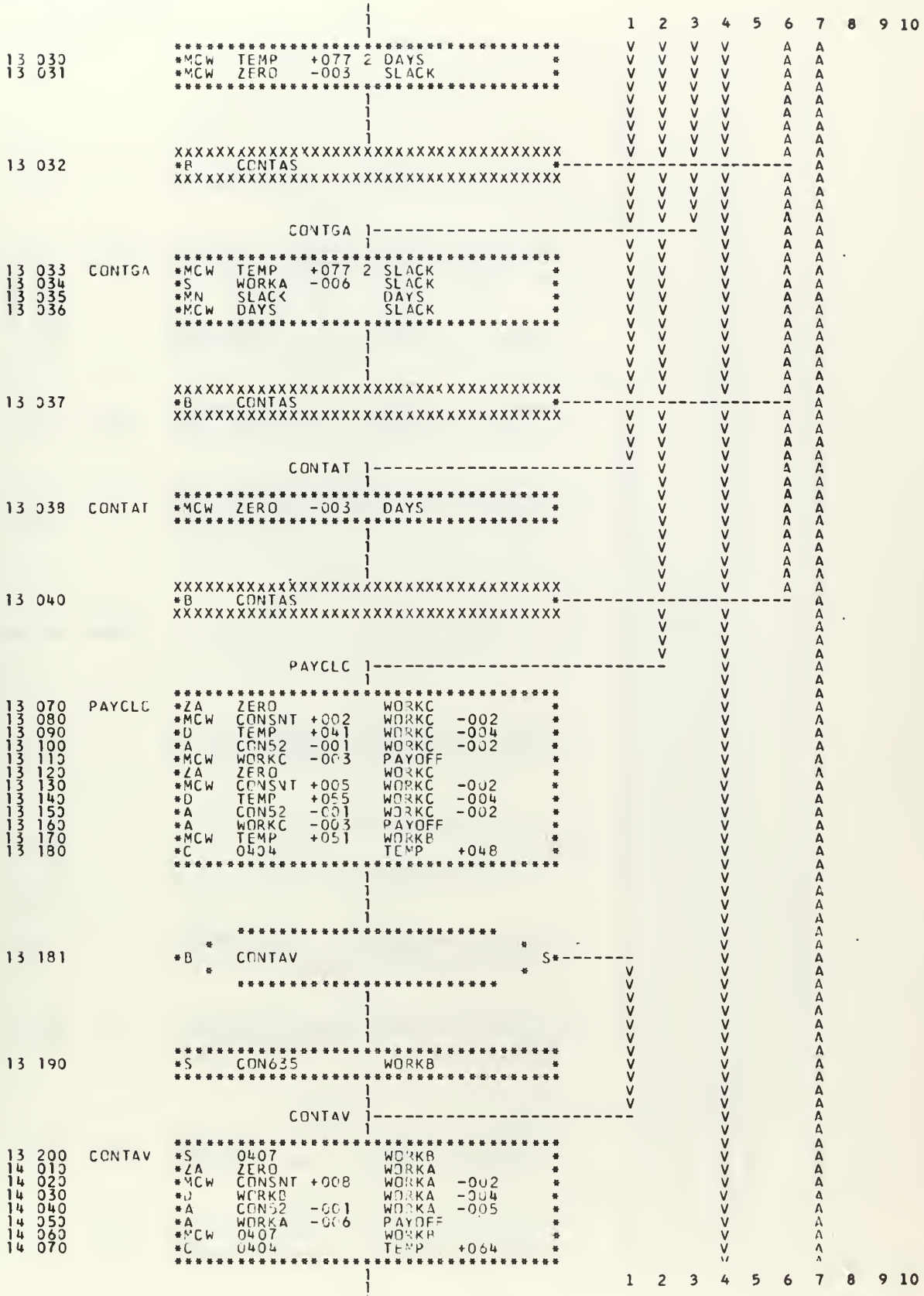

1 2 3 4 5 6 7 8 9 10
8 070
*MCW UPDATE +051 TEMP +051 *
CONTZ
8 080 CONTZ *B CONTAA UPDATE +055 *
8 110
*MCW UPDATE +055 TEMP +055 *
CONTAA
8 120 CONTAA *B CONTAB UPDATE +062 *
8 150
*MCW UPDATE +062 TEMP +062 *
CONTAB
8 160 CONTAB *B CONTAC UPDATE +067 *
8 190
*MCW UPDATE +067 TEMP +067 *
CONTAC
8 200 CONTAC *B CONTAD UPDATE +073 *
9 030
*MCW UPDATE +073 TEMP +073 *
CONTAD
9 040 CONTAD *B CONTAE UPDATE +079 *
9 070
*MCW UPDATE +079 TEMP +079 *
CONTAE
9 080 CONTAE *B RLVISE *
1 2 3 4 5 6 7 8 9 10

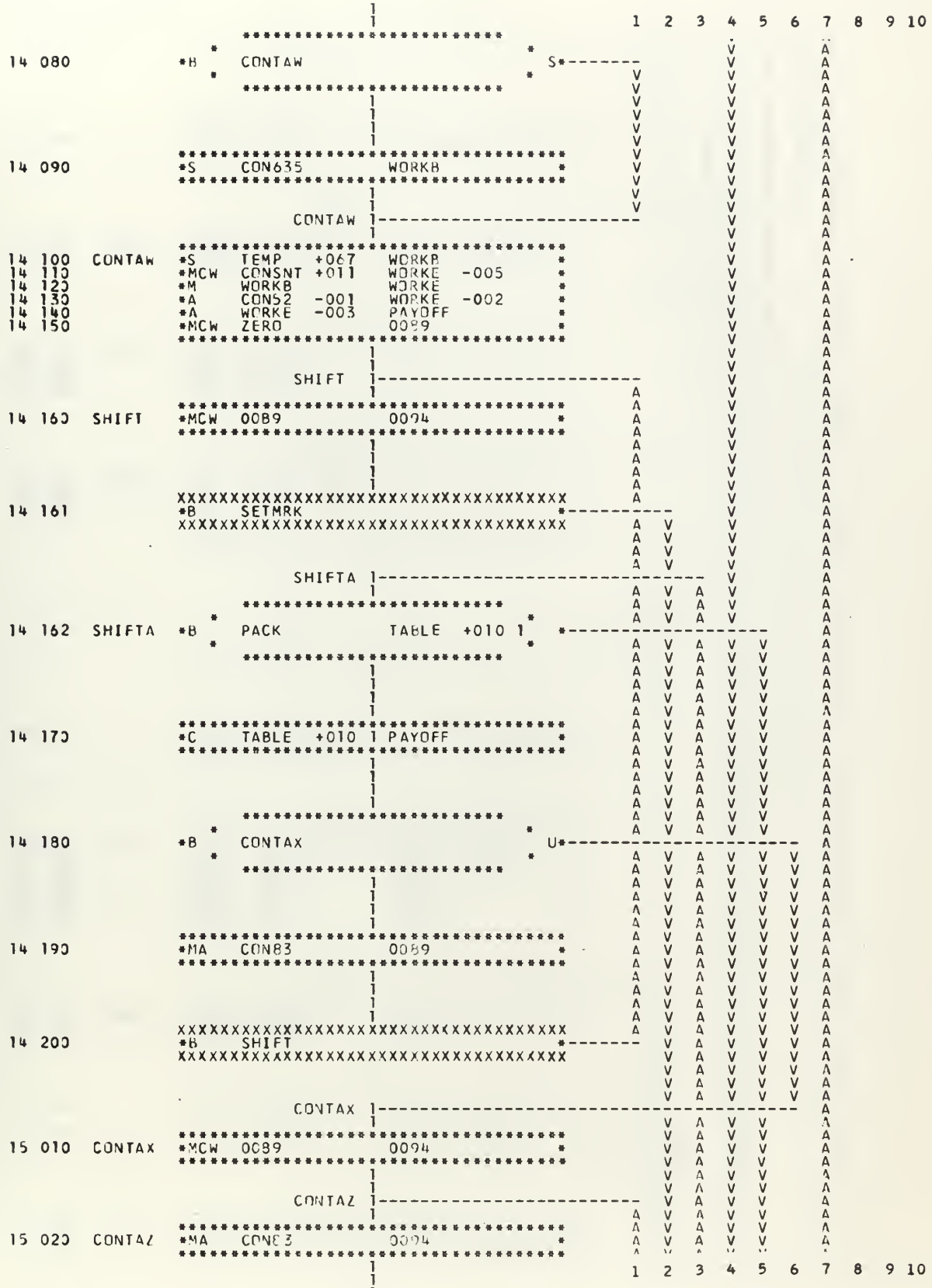

1 2 3 4 5 6 7 8 9 10
9 090
CONTH
CONTK
9 100 CONTK
NEWJOB TEMP +035 4
9 110
0407 TEMP +046
9 120
NEWJOB U
9 130
MCW ZERO 0004
CONTAE
9 140 CONTAE
0426 2 TEMP +035
9 150
DATA S
9 160
MA CON01 0004
9 170
NEWJOB 0004 G
9 171
CONTAE
DATA
9 180 DATA
MCW ZERO WCNT
9 190
MCW ZERO 0009
9 200
MCW ZERO REPEAT
CONTAL
10 010 CONTAL
A CON150 -002 WCNT
10 011
MA CON52 0009
10 012
MCW ZERO ENTRY
10 020
S CON9 WCNT
1 2 3 4 5 6 7 8 9 10

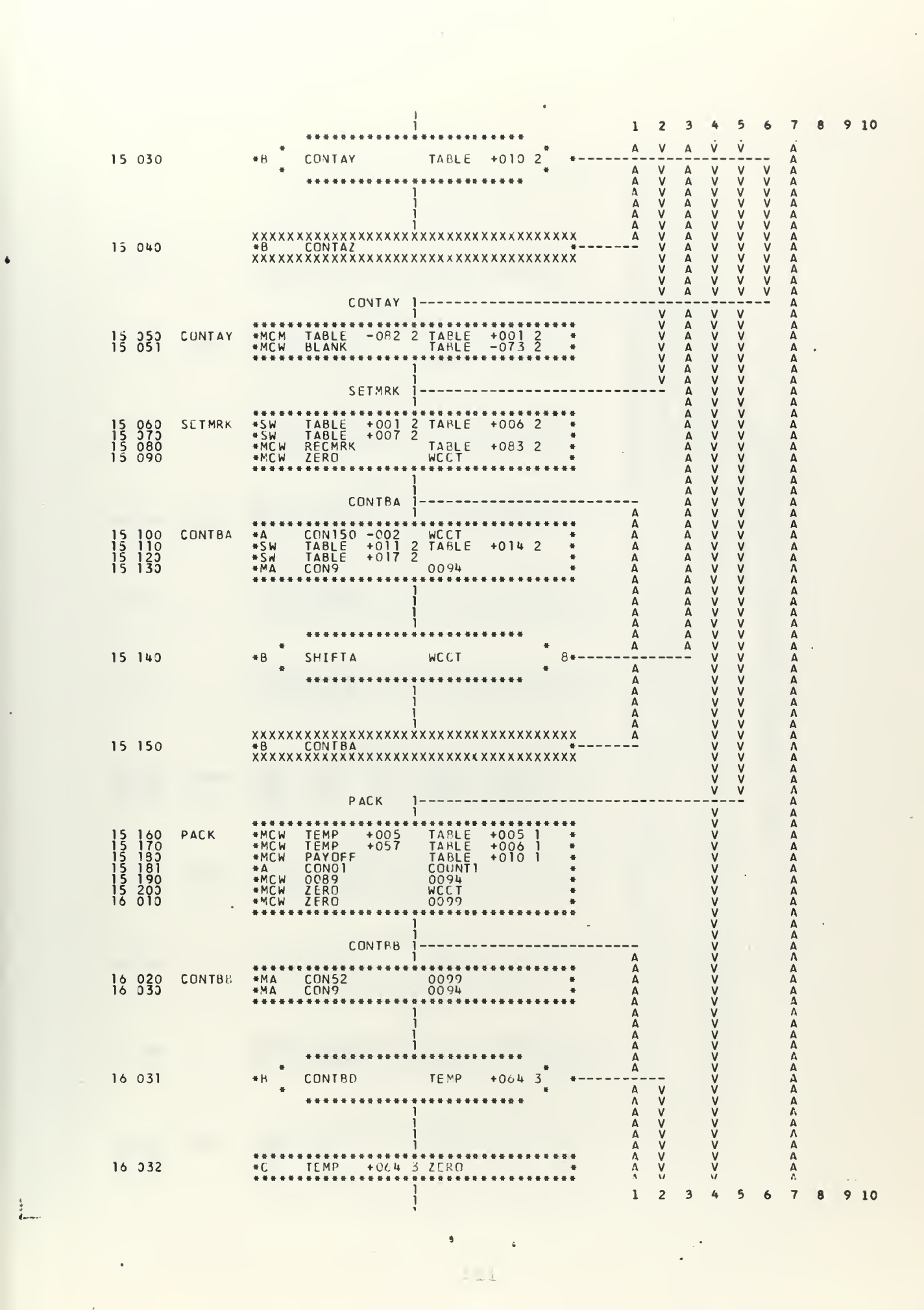

1 2 3 4 5 6 7 8 9 10
10 030 *B CONTAG T*
10 040 *B DATA REPEAT 1*
10 050 *B PAYCLC
CONTAG
10 060 CONTAG *C CON01 TEMP +064 1 *
10 070 *B CONTAL T*
10 080 *C BLANK -003 TEMP +077 1 *
10 090 *B CONTAL U*
10 100 *C ZERO -003 TEMP +043 1 *
10 110 *B CONTAM U*
CONTAO
10 120 CONTAO *MCW 0408 DAYS *
10 130 *MCW 0408 SLACK *
CONTAS
10 131 CONTAS *C ZERO -002 TEMP +067 1 *
10 132 *B CONTFA U*
10 140 *C TEMP +068 1 DAYS *
1 2 3 4 5 6 7 8 9 10

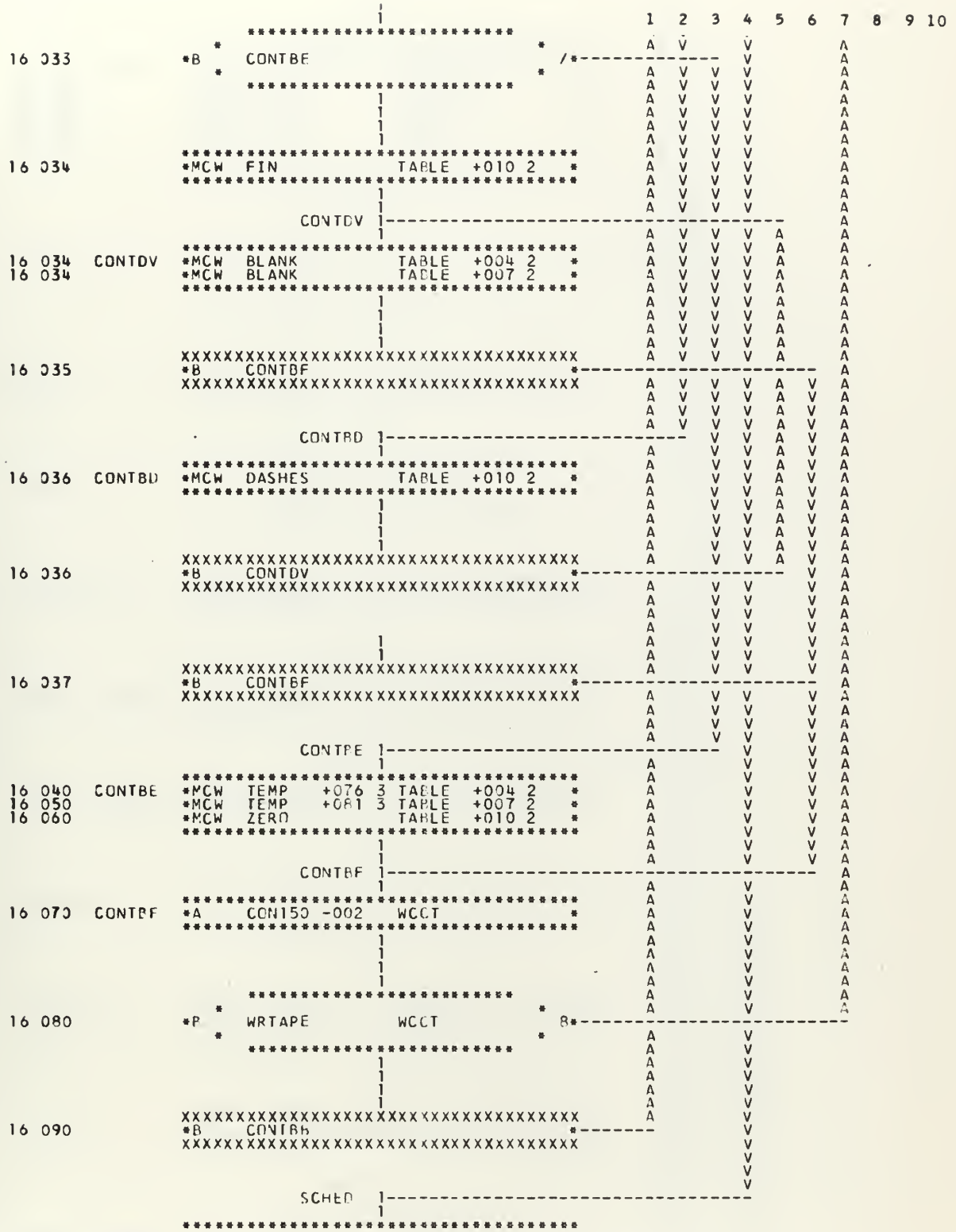

1 2 3 4 5 6 7 8 9 10
10 141 *B CONTAU U*
CONTFA
10 142 CONTFA *MCW DAYS TEMP +070 1
10 143 *B CONTDQ
CONTAU
10 144 CONTAU *MCW TEMP +068 1 TEMP +070 1
CONTDQ
10 150 CONTDQ *ZA ZERO WORKA
10 160 *MCW TEMP +064 1 WORKA -002
10 170 *D TEMP +068 1 WORKA -005
10 180 *A CON52 -001 WORKA -004
10 190 *MCW TEMP +070 1 WORKC -006
10 200 *M WORKA -005 WORKC
11 010 *A CON52 -001 WORKA -005
11 020 *MCW WORKA -006 TEMP +073 1
11 030 *MCW WORKC -001 TEMP +076 1
11 040 *MCW SLACK TEMP +077 1
11 050 *MCW ENTRY TEMP +081 1
11 060 *MCW ZERO ENTRY
11 070 *B CONTAL
CONTAM
11 080 CONTAM *MCW ZERO 0094
CONTAN
11 090 CONTAN *MA CON52 0094
11 100 *C TEMP +043 1 TEMP +050 2
11 110 *B CONTAN T*
11 120 *C CON01 TEMP +064 2
11 130 *C CONTAC T*
11 140 *C BLANK -003 TEMP +077 2
1 2 3 4 5 6 7 8 9 10

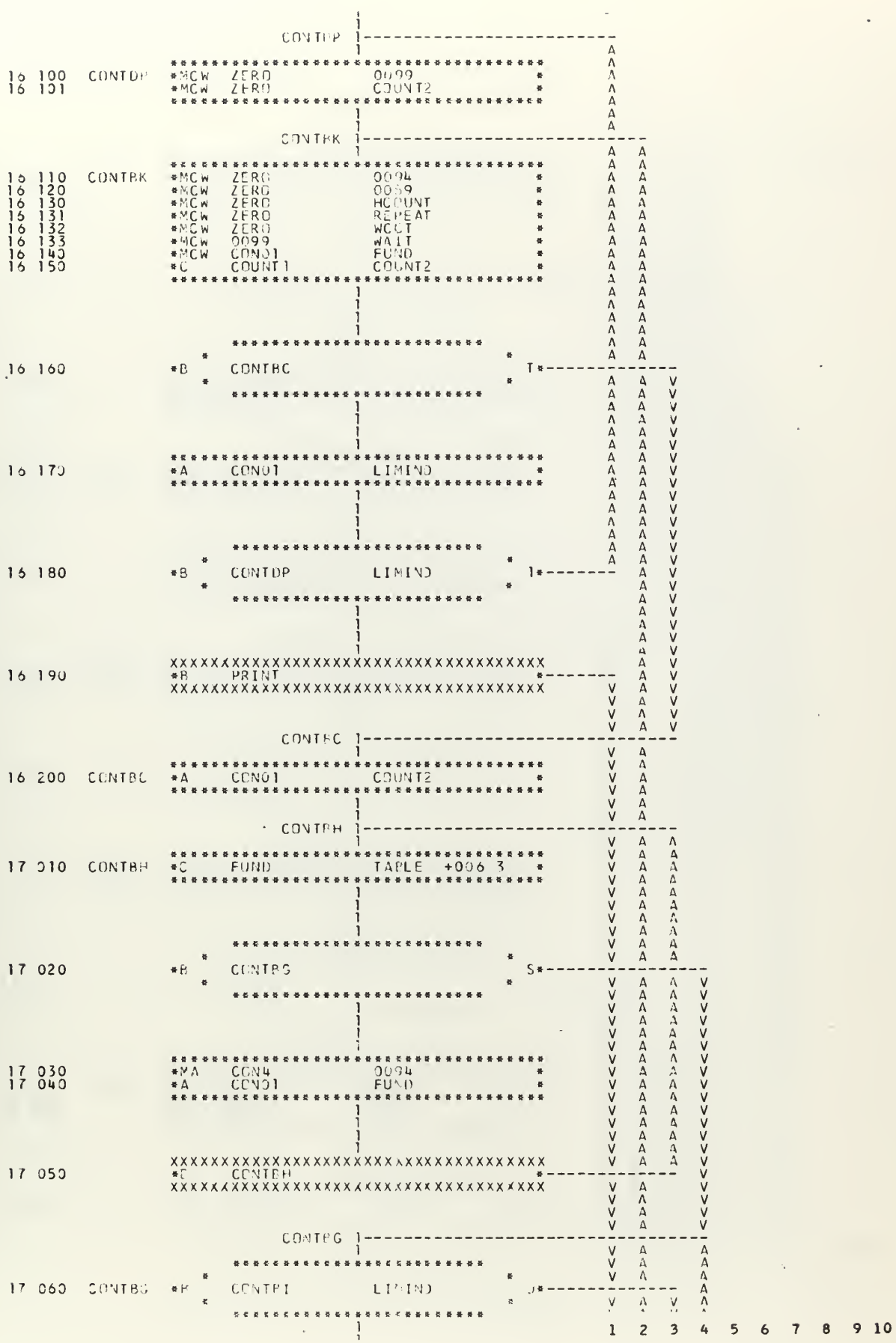

1 2 3 4 5 6 7 8 9 10
11 150 *B CONTAQ U*
11 160 *MCW CON150 -002 REPEAT *
11 170 *C CONTAL
CONTAQ
11 200 CONTAQ *MCW TEMP +059 2 WORKB *
12 010 *A TEMP +064 2 WORKB *
12 020 *MCW TEMP +047 1 WORKE -005 *
12 030 *M WORKB WORKE *
12 040 *A CON52 -001 WORKE -001 *
12 050 *C WORKE -002 TEMP +059 2 *
12 060 *B CONTAR T*
12 070 *MCW SLACK DAYS *
12 090 *B CONTAS
CONTAR
12 100 CONTAR *MCW TEMP +059 2 WORKB *
12 110 *A TEMP +076 2 WORKB *
12 120 *C WORKE -002 WORKB *
12 130 *B CONTAT T*
12 140 *MCW WORKE -002 WORKB *
12 150 *S TEMP +059 2 WORKB *
12 151 *MN WORKB ENTRY *
12 152 *MCW WORKB -001 ENTRY -001 *
12 153 *A TEMP +081 2 ENTRY *
12 160 *ZA ZERO WORKA *
12 170 *MN WORKB WORKA -002 *
12 180 *MCW WORKB -001 WORKA -003 *
12 190 *U TEMP +073 2 WORKA -005 *
12 200 *A CON52 -001 WORKA -005 *
13 010 *C WORKA -006 TEMP +077 2 *
13 020 *B CONTGA U*
1 2 3 4 5 6 7 8 9 10

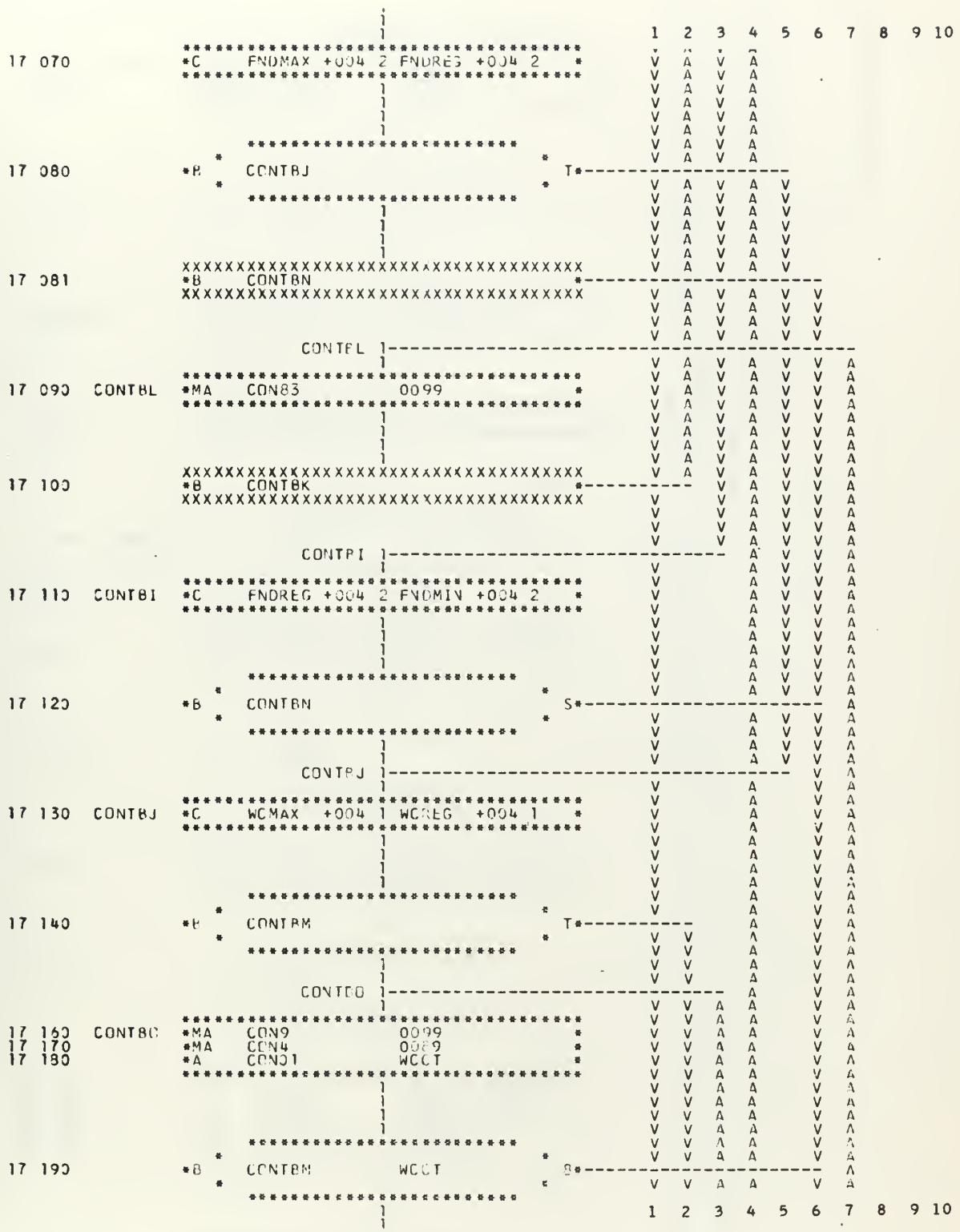

1 2 3 4 5 6 7 8 9 10
13 030 *MCW TEMP +077 2 DAYS
13 031 *MCW ZERO -003 SLACK
13 032 *B CONTAS
CONTGA
13 033 CONTGA *MCW TEMP +077 2 SLACK
13 034 *S WORKA -006 SLACK
13 035 *MN SLACK DAYS
13 036 *MCW DAYS SLACK
13 037 *B CONTAS
CONTAT
13 038 CONTAT *MCW ZERO -003 DAYS
13 040 *B CONTAS
PAYCLC
13 070 PAYCLC *ZA ZERO WORKC
13 080 *MCW CONSNT +002 WORKC -002
13 090 *D TEMP +041 WORKC -004
13 100 *A CON52 -001 WORKC -002
13 110 *MCW WORKC -003 PAYOFF
13 120 *ZA ZERO WORKC
13 130 *MCW CONSNT +005 WORKC -002
13 140 *D TEMP +055 WORKC -004
13 150 *A CON52 -001 WORKC -002
13 160 *A WORKC -003 PAYOFF
13 170 *MCW TEMP +051 WORKB
13 180 *C 0404 TEMP +048
13 181 *B CONTAV S
13 190 *S CON635 WORKB
CONTAV
13 200 CONTAV *S 0407 WORKB
14 010 *ZA ZERO WORKA
14 020 *MCW CONSNT +008 WORKA -002
14 030 *D WORKB WORKA -004
14 040 *A CON52 -001 WORKA -005
14 050 *A WORKA -006 PAYOFF
14 060 *MCW 0407 WORKB
14 070 *C 0404 TEMP +064
1 2 3 4 5 6 7 8 9 10

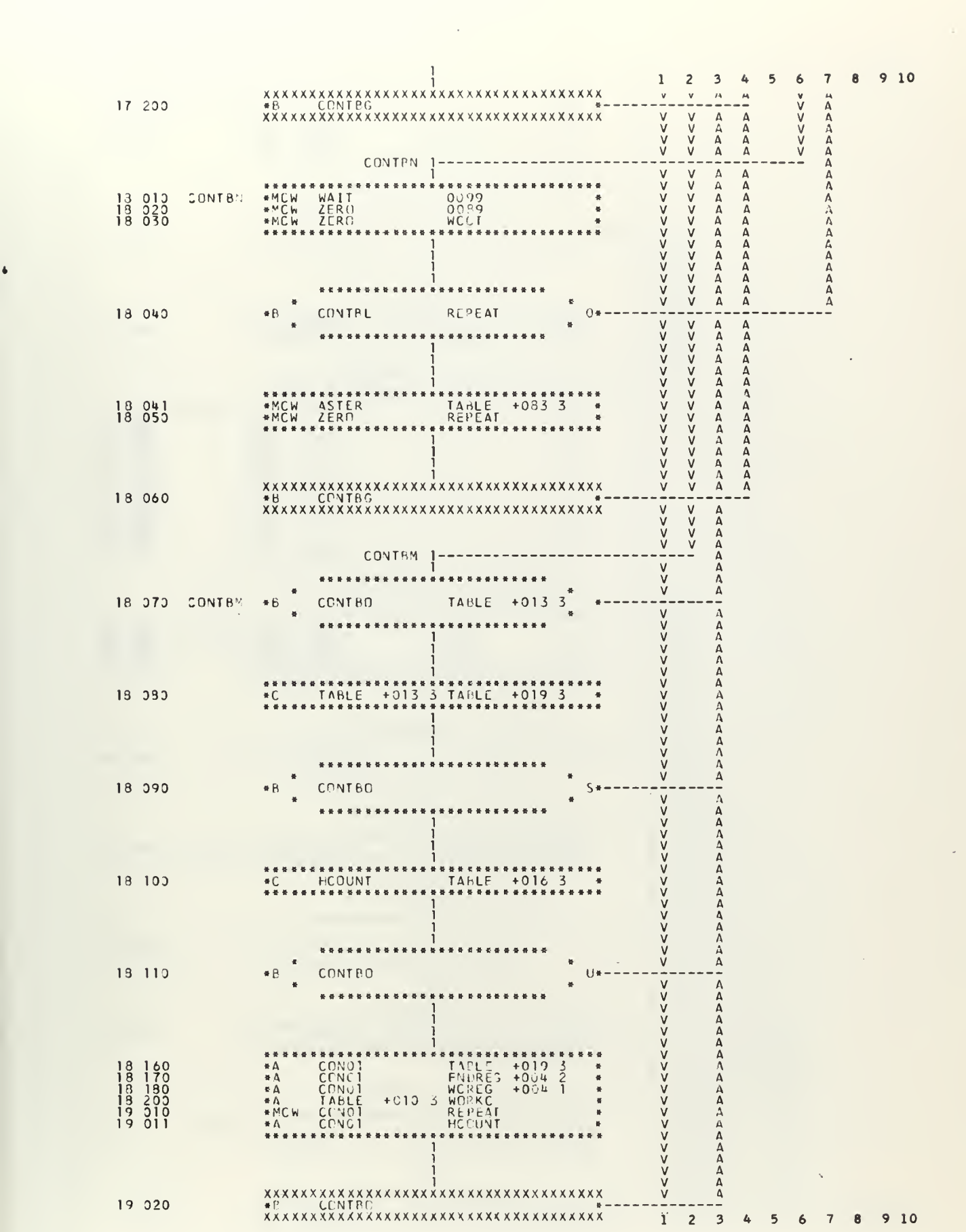

1 2 3 4 5 6 7 8 9 10
14 080 *B CONTAW S
14 090 *S CON635 WORKB
CONTAW
14 100 CONTAW *S TEMP +067 WORKB
14 110 *MCW CONSNT +011 WORKE -005
14 120 *M WORKB WORKE
14 130 *A CONS2 -001 WORKE -002
14 140 *A WORKE -003 PAYOFF
14 150 *MCW ZERO 0089
SHIFT
14 160 SHIFT *MCW 0089 0094
14 161 *B SETMRK
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
SHIFTA
14 162 SHIFTA *B PACK TABLE +010 1
14 170 *C TABLE +010 1 PAYOFF
14 180 *B CONTAX U
14 190 *MA CON83 0089
14 200 *B SHIFT
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
CONTAX
15 010 CONTAX *MCW 0089 0094
CONTAZ
15 020 CONTAZ *MA CONE3 0094
1 2 3 4 5 6 7 8 9 10

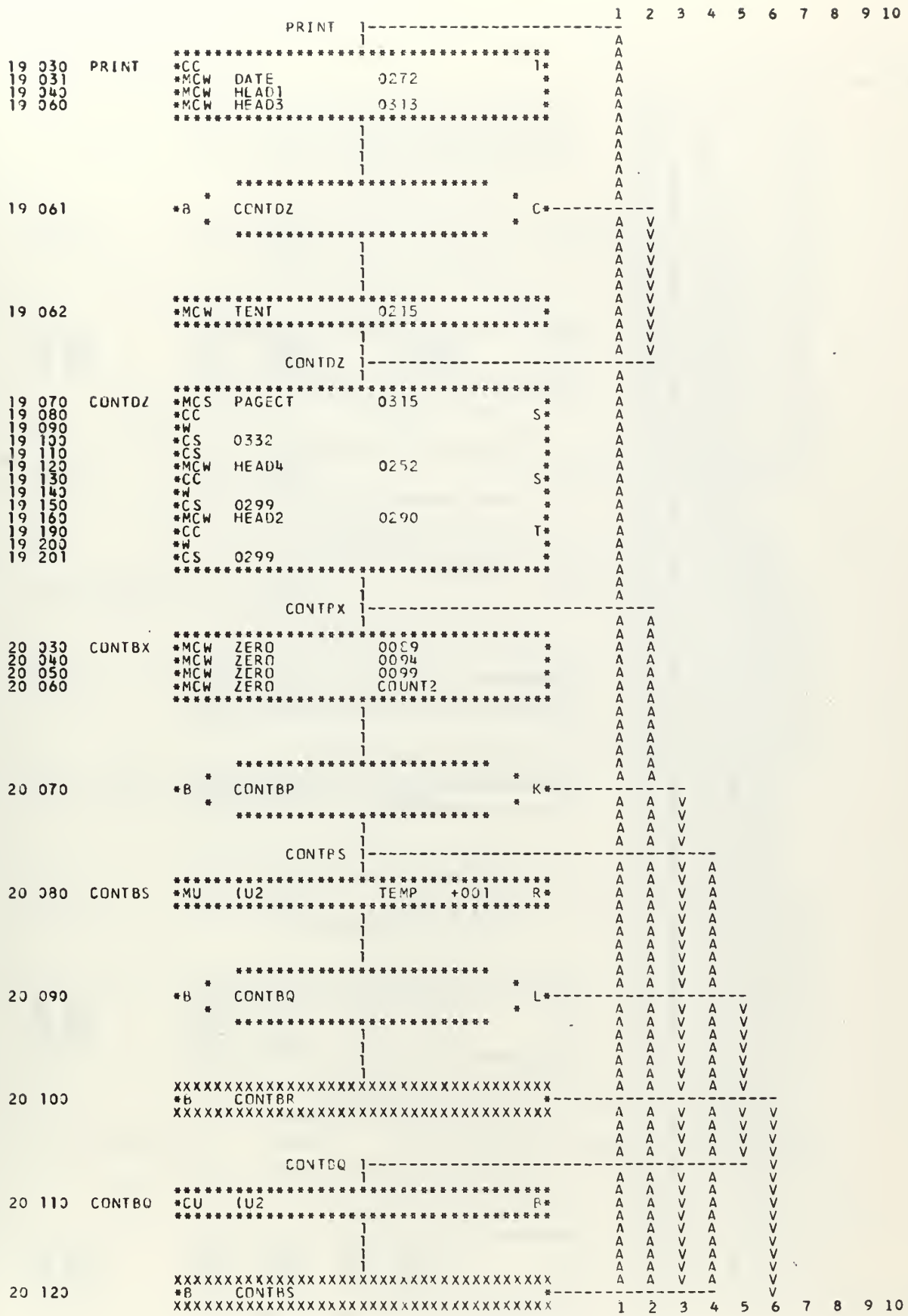

1 2 3 4 5 6 7 8 9 10
15 030 *B CONTAY TABLE +010 2
15 040 *B CONTAZ
CONTAY
15 050 CONTAY *MCM TABLE -082 2 TABLE +001 2
15 051 *MCW BLANK TABLE -073 2
SETMRK
15 060 SETMRK *SW TABLE +001 2 TABLE +006 2
15 070 *SW TABLE +007 2
15 080 *MCW RECMRK TABLE +083 2
15 090 *MCW ZERO WCCT
CONTBA
15 100 CONTBA *A CON150 -002 WCCT
15 110 *SW TABLE +011 2 TABLE +014 2
15 120 *SW TABLE +017 2
15 130 *MA CON9 0094
15 140 *B SHIFTA WCCT 8
15 150 *B CONTBA
PACK
15 160 PACK *MCW TEMP +005 TABLE +005 1
15 170 *MCW TEMP +057 TABLE +006 1
15 180 *MCW PAYOFF TABLE +010 1
15 181 *A CON01 COUNT1
15 190 *MCW 0089 0094
15 200 *MCW ZERO WCCT
16 010 *MCW ZERO 0099
CONTBB
16 020 CONTBB *MA CON52 0099
16 030 *MA CON9 0094
16 031 *B CONTBD TEMP +064 3
16 032 *C TEMP +064 3 ZERO
1 2 3 4 5 6 7 8 9 10

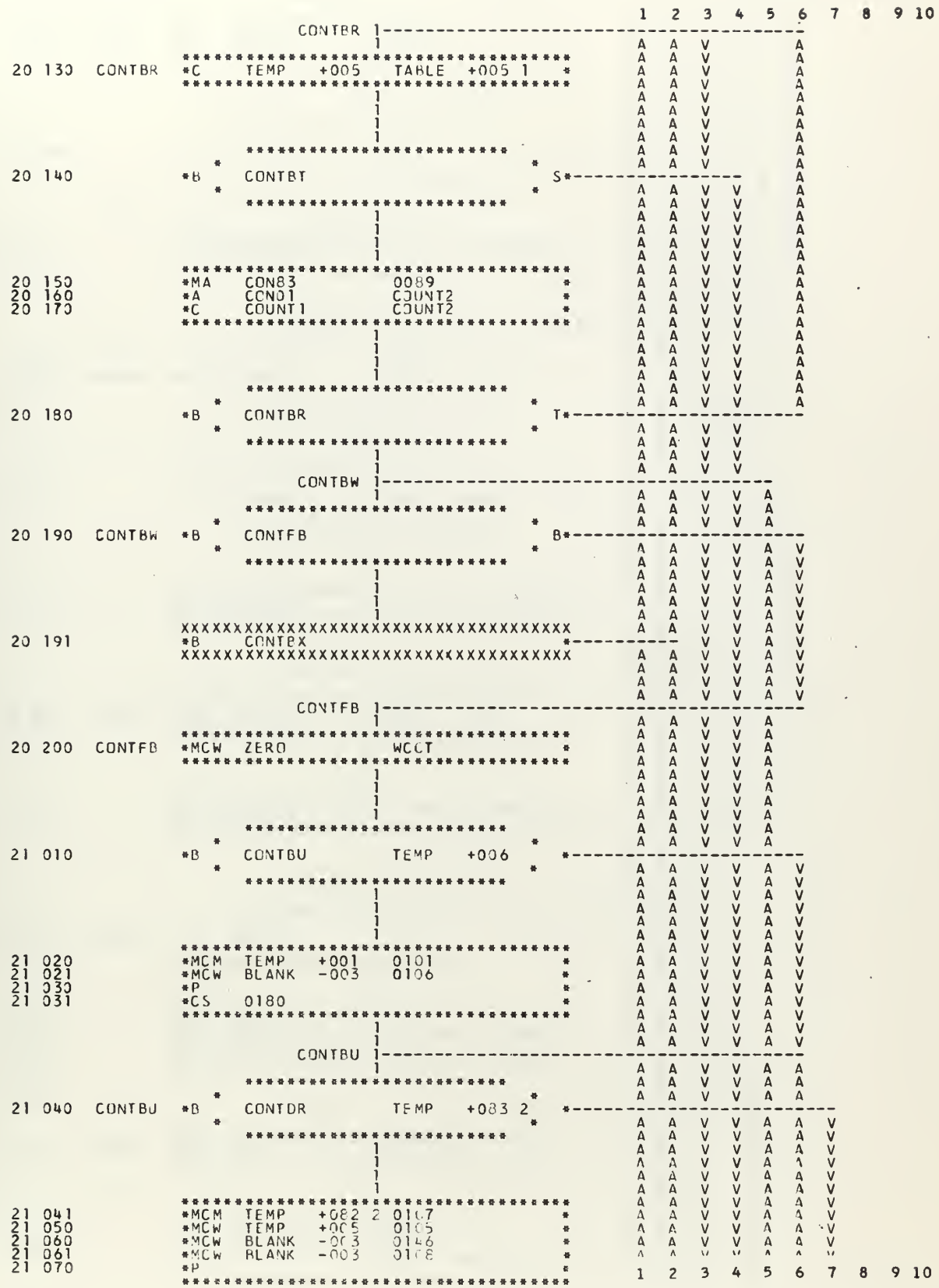

1 2 3 4 5 6 7 8 9 10
16 033 *B CONTBE /*
16 034 *MCW FIN TABLE +010 2 *
CONTDV
16 034 CONTDV *MCW BLANK TABLE +004 2 *
16 034 *MCW BLANK TABLE +007 2 *
16 035 *B CONTBF *
CONTBD
16 036 CONTBD *MCW DASHES TABLE +010 2 *
16 036 *B CONTDV *
16 037 *B CONTBF *
CONTBE
16 040 CONTBE *MCW TEMP +076 3 TABLE +004 2 *
16 050 *MCW TEMP +081 3 TABLE +007 2 *
16 060 *MCW ZERO TABLE +010 2 *
CONTBF
16 070 CONTBF *A CON150 -002 WCCT *
16 080 *P WRTAPE WCCT 8*
16 090 *B CONTB6 *
SCHED
16 091 SCHED *MCW ZERO WORKC *
16 092 *MCW ZERO WORKC -004 *
16 093 *CU CU2 M*
16 094 *CU CU2 R*

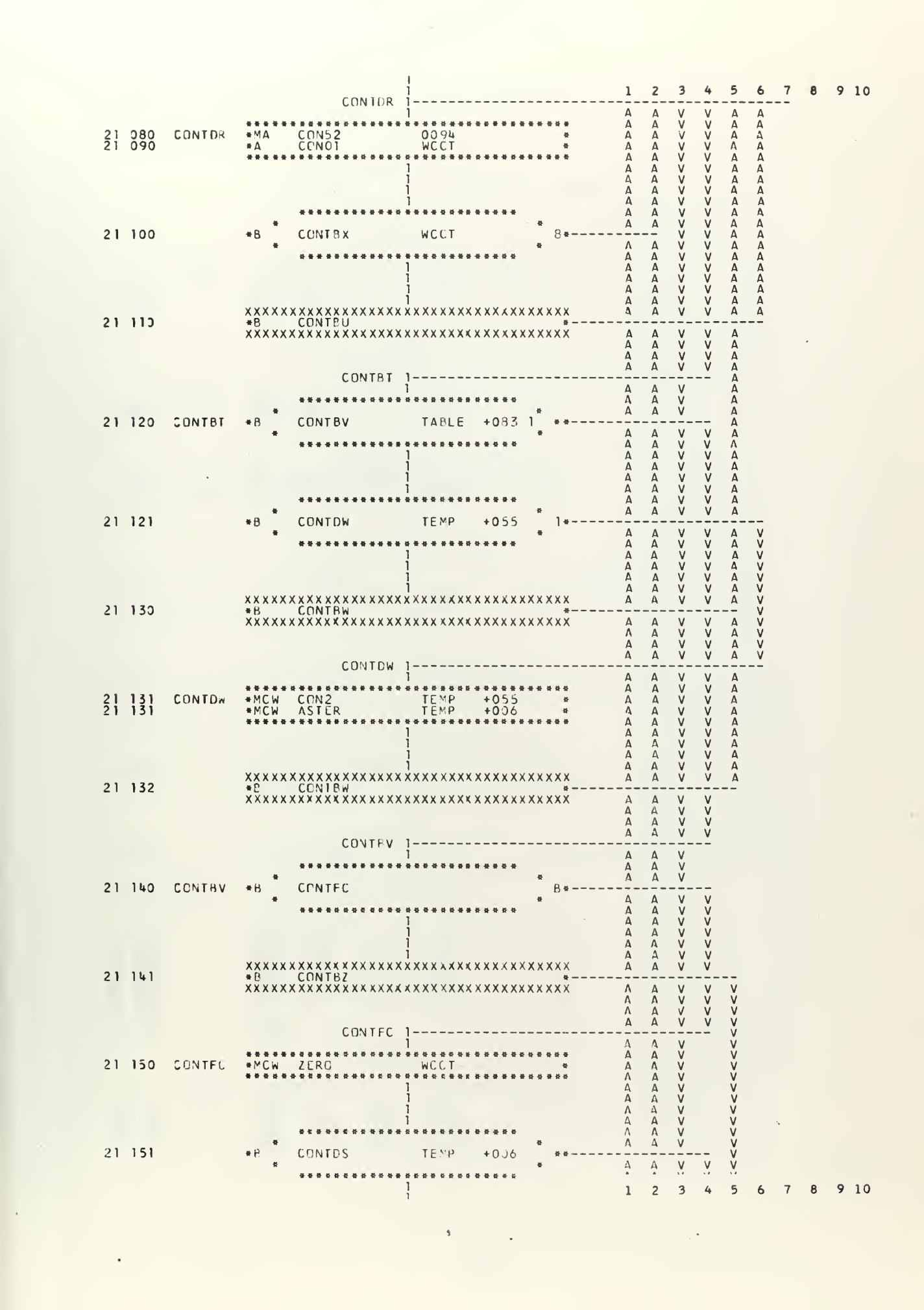

CONTDP
16 100 CONTDP *MCW ZERO 0099 *
16 101 *MCW ZERO COUNT2 *
CONTBK
16 110 CONTBK *MCW ZERO 0094 *
16 120 *MCW ZERO 0089 *
16 130 *MCW ZERO HCOUNT *
16 131 *MCW ZERO REPEAT *
16 132 *MCW ZERO WCUT *
16 133 *MCW 0099 WAIT *
16 140 *MCW CON01 FUND *
16 150 *C COUNT1 COUNT2 *
16 160 *B CONTBC T*
16 170 *A CON01 LIMIND *
16 180 *B CONTDP LIMIND 1*
16 190 *B PRINT *
CONTBC
16 200 CONTBC *A CON01 COUNT2 *
CONTBH
17 010 CONTBH *C FUND TABLE +006 3 *
17 020 *B CONTBG S*
17 030 *MA CON4 0094 *
17 040 *A CON01 FUND *
17 050 *E CONTBH *
CONTBG
17 060 CONTBG *B CONTPI LIMIND J*
1 2 3 4 5 6 7 8 9 10

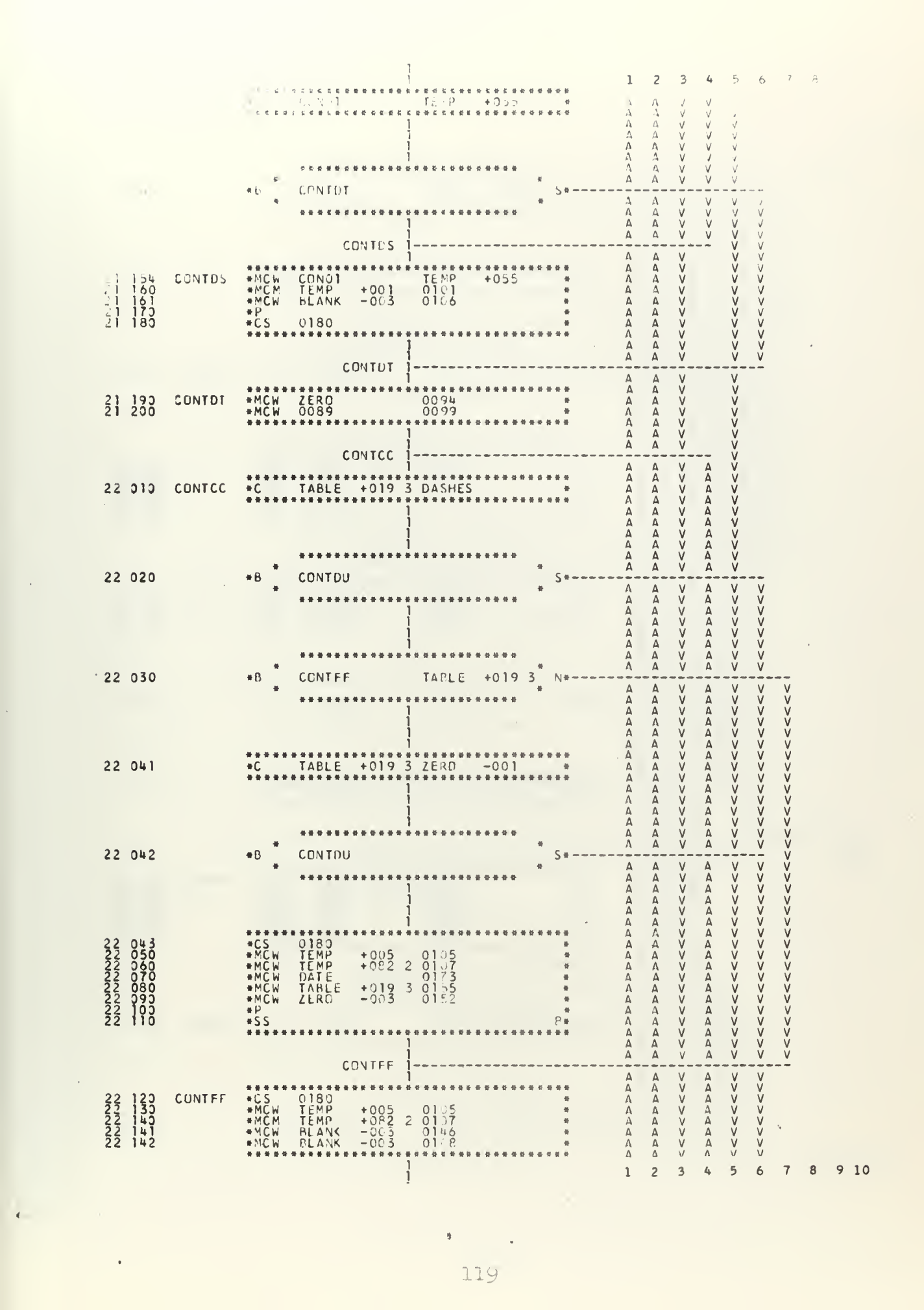

1 2 3 4 5 6 7 8 9 10
17 070
*C FNDMAX +004 2 FNDREG +004 2 *
17 080
B CONTBJ T
17 081
*B CONTBN *
CONTBL
17 090 CONTBL
*MA CON83 0099 *
17 100
*B CONTBK *
CONTBI
17 110 CONTBI
*C FNDREG +004 2 FNDMIN +004 2 *
17 120
B CONTBN S
CONTBJ
17 130 CONTBJ
*C WCMAX +004 1 WCREG +004 1 *
17 140
B CONTBM T
CONTBC
17 160 CONTBC
*MA CON9 0099 *
17 170
*MA CON4 0089 *
17 180
*A CON31 WCCT *
17 190
B CONTBN WCCT 9
1 2 3 4 5 6 7 8 9 10

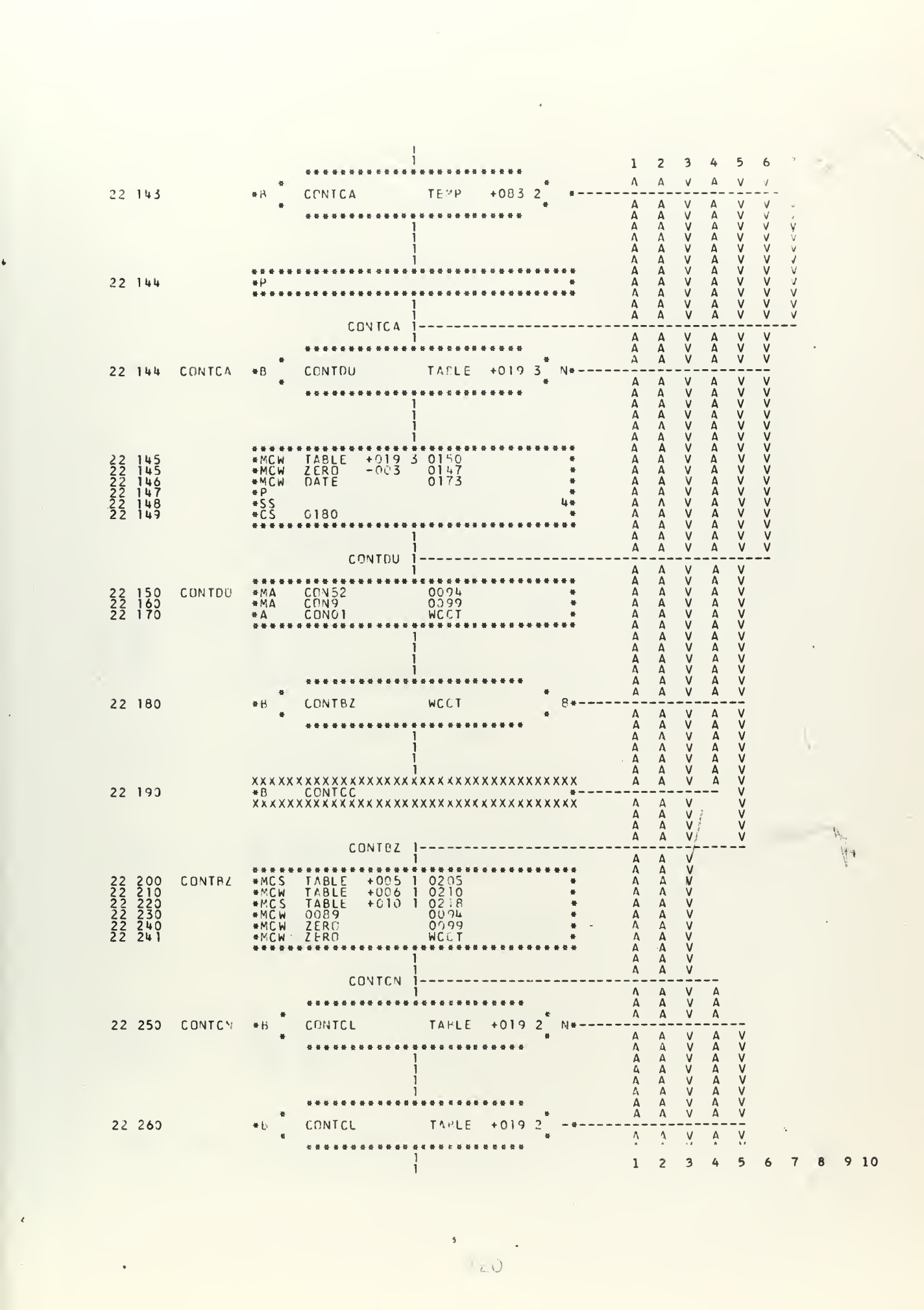

1 2 3 4 5 6 7 8 9 10
17 200 *B CONTBG
CONTBN
13 010 CONTBN *MCW WAIT 0099
18 020 *MCW ZERO 0089
18 030 *MCW ZERO WCCT
18 040 *B CONTBL REPEAT 0
18 041 *MCW ASTER TABLE +083 3
18 050 *MCW ZERO REPEAT
18 060 *B CONTBG
CONTBM
18 070 CONTBM *B CONTBO TABLE +013 3
18 080 *C TABLE +013 3 TABLE +019 3
18 090 *B CONTBO S
18 100 *C HCOUNT TABLE +016 3
18 110 *B CONTBO U
18 160 *A CONO1 TABLE +019 3
18 170 *A CONC1 ENDREG +004 2
18 180 *A CONV1 WCREG +004 1
18 200 *A TABLE +010 3 WORKC
19 010 *MCW CONO1 REPEAT
19 011 *A CONC1 HCOUNT
19 020 *B CONTBO

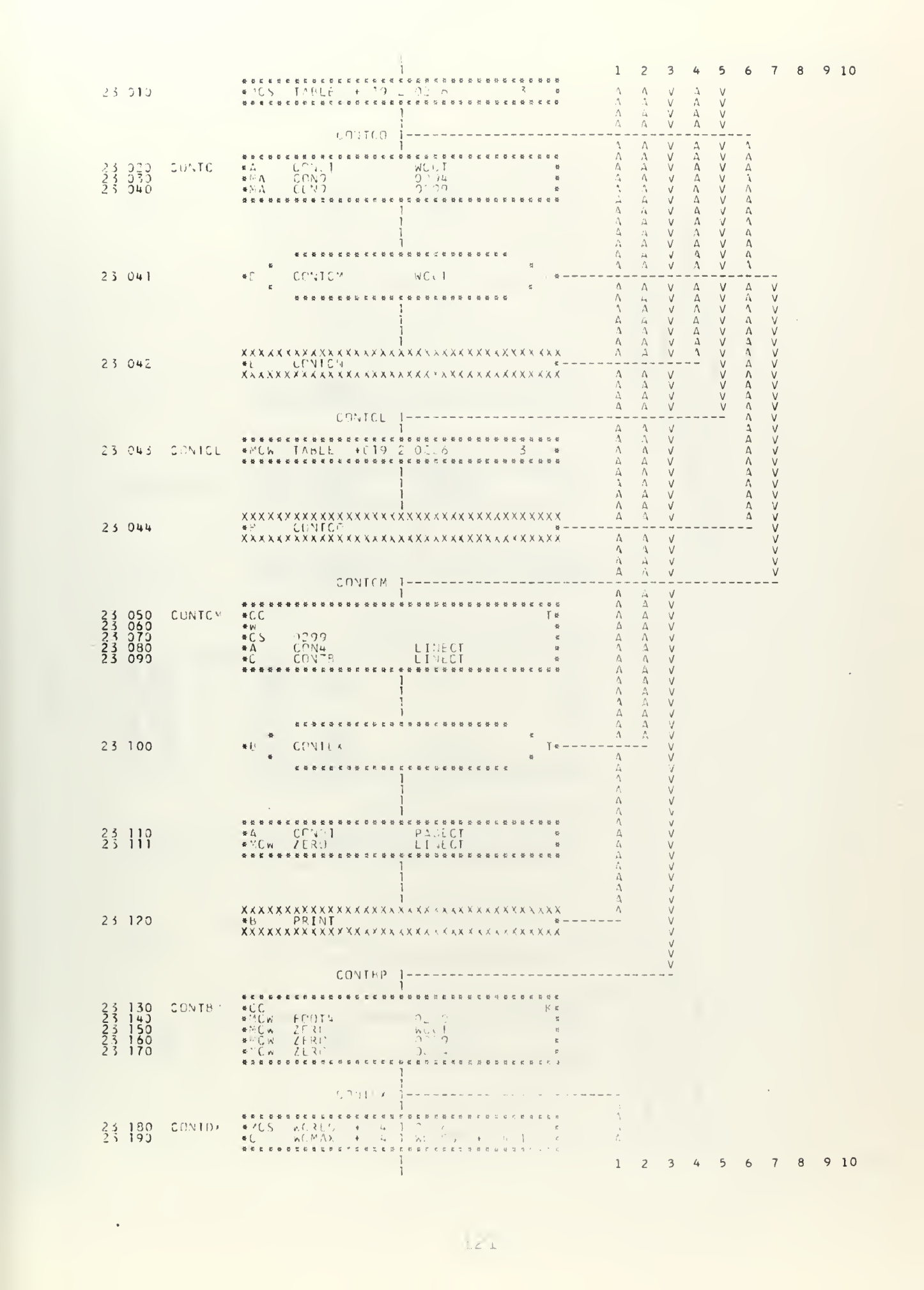

PRINT
19 030 PRINT *CC 1*
19 031 *MCW DATE 0272 *
19 040 *MCW HEAD1 *
19 060 *MCW HEAD3 0313 *
19 061 *B CONTDZ C*
19 062 *MCW TENT 0215 *
CONTDZ
19 070 CONTDZ *MCS PAGECT 0315 *
19 080 *CC S*
19 090 *W *
19 100 *CS 0332 *
19 110 *CS *
19 120 *MCW HEAD4 0252 *
19 130 *CC S*
19 140 *W *
19 150 *CS 0299 *
19 160 *MCW HEAD2 0290 *
19 190 *CC T*
19 200 *W *
19 201 *CS 0299 *
CONTPX
20 030 CONTBX *MCW ZERO 0089 *
20 040 *MCW ZERO 0094 *
20 050 *MCW ZERO 0099 *
20 060 *MCW ZERO COUNT2 *
20 070 *B CONTBP K*
CONTBS
20 080 CONTBS *MU (U2 TEMP +001 R*
20 090 *B CONTBQ L*
20 100 *B CONTBR *
CONTBQ
20 110 CONTBQ *CU (U2 B*
20 120 *B CONTBS *
1 2 3 4 5 6 7 8 9 10

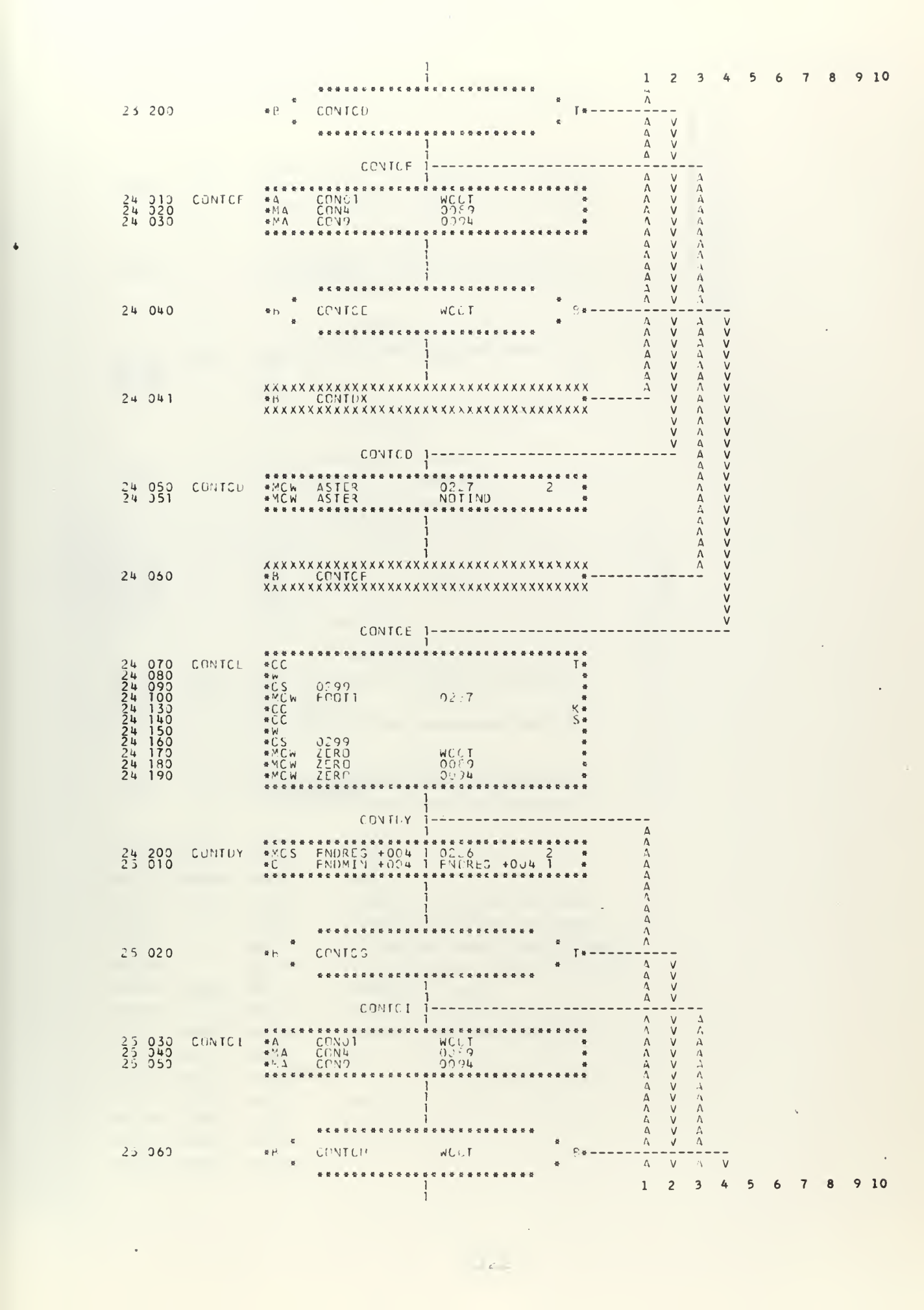

CONTBR
20 130 CONTBR *C TEMP +005 TABLE +005 1
20 140 *B CONTBT S
20 150 *MA CON83 0089
20 160 *A CON01 COUNT2
20 170 *C COUNT1 COUNT2
20 180 *B CONTBR T
CONTBW
20 190 CONTBW *B CONTFB B
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
20 191 *B CONTBX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
CONTFB
20 200 CONTFB *MCW ZERO WCCT
21 010 *B CONTBU TEMP +006
21 020 *MCM TEMP +001 0101
21 021 *MCW BLANK -003 0106
21 030 *P
21 031 *CS 0180
CONTBU
21 040 CONTBU *B CONTDR TEMP +083 2
21 041 *MCM TEMP +082 2 0107
21 050 *MCW TEMP +005 0105
21 060 *MCW BLANK -003 0146
21 061 *MCW BLANK -003 0108
21 070 *P
1 2 3 4 5 6 7 8 9 10


CONTDR
21 080 CONTDR *MA CON52 0094
21 090 *A CONOT WCCT
21 100 *B CONTBX WCCT 8
21 110 *B CONTBU
CONTBT
21 120 CONTBT *B CONTBV TABLE +083 1
21 121 *B CONTDW TEMP +055 1
21 130 *B CONTBW
CONTDW
21 131 CONTDW *MCW CON2 TEMP +055
21 131 *MCW ASTER TEMP +006
21 132 *B CONTBW
CONTBV
21 140 CONTBV *B CONTEC B
21 141 *B CONTBZ
CONTEC
21 150 CONTEC *MCW ZERO WCCT
21 151 *B CONTDS TEMP +006
1 2 3 4 5 6 7 8 9 10


CONDI TEMP +055
*B CONTDT S
CONTDS
21 154 CONTDS *MCW CONDI TEMP +055
21 160 *MCM TEMP +001 0101
21 161 *MCW BLANK -003 0106
21 170 *P
21 180 *CS 0180
CONTDT
21 190 CONTDT *MCW ZERO 0094
21 200 *MCW 0089 0099
CONTCC
22 010 CONTCC *C TABLE +019 3 DASHES
22 020 *B CONTDU S
22 030 *B CONTFF TABLE +019 3 N
22 041 *C TABLE +019 3 ZERO -001
22 042 *B CONTDU S
22 043 *CS 0180
22 050 *MCW TEMP +005 0105
22 060 *MCW TEMP +002 2 0107
22 070 *MCW DATE 0173
22 080 *MCW TABLE +019 3 0155
22 090 *MCW ZERO -003 0152
22 100 *P
22 110 *SS P
CONTFF
22 120 CONTFF *CS 0180
22 130 *MCW TEMP +005 0105
22 140 *MCM TEMP +002 2 0107
22 141 *MCW BLANK -003 0146
22 142 *MCW BLANK -003 0148
1 2 3 4 5 6 7 8 9 10


22 143 *B CONTCA TEMP +083 2
22 144 *P
CONTCA
22 144 CONTCA *B CONTDU TABLE +019 3 N
22 145 *MCW TABLE +019 3 0150
22 145 *MCW ZERO -003 0147
22 146 *MCW DATE 0173
22 147 *P
22 148 *SS 4
22 149 *CS 0180
CONTDU
22 150 CONTDU *MA CON52 0094
22 160 *MA CON9 0099
22 170 *A CON01 WCCT
22 180 *B CONTBZ WCCT 8
22 190 *B CONTCC
CONTBZ
22 200 CONTBZ *MCS TABLE +005 1 0205
22 210 *MCW TABLE +006 1 0210
22 220 *MCS TABLE +010 1 0218
22 230 *MCW 0089 0094
22 240 *MCW ZERO 0099
22 241 *MCW ZERO WCCT
CONTCN
22 250 CONTCN *B CONTCL TABLE +019 2 N
22 260 *B CONTCL TABLE +019 2
1 2 3 4 5 6
1 2 3 4 5 6 7 8 9 10




1 2 3 4 5 6 7 8 9 10
25 200 *B CONTCD T*
CONTCF
24 010 CONTCF *A CONC1 WCCT *
24 020 *MA CON4 0089 *
24 030 *MA CON9 0094 *
24 040 *B CONTCE WCCT 9*
24 041 *B CONTDX *
CONTCD
24 050 CONTCD *MCW ASTER 0287 2 *
24 051 *MCW ASTER NOTIND *
24 060 *B CONTCF *
CONTCE
24 070 CONTCL *CC T*
24 080 *W *
24 090 *CS 0299 *
24 100 *MCW ROOT1 0287 *
24 130 *CC K*
24 140 *CC S*
24 150 *W *
24 160 *CS 0299 *
24 170 *MCW ZERO WCCT *
24 180 *MCW ZERO 0089 *
24 190 *MCW ZERO 0094 *
CONTDY
24 200 CONTDY *MCS ENDREG +004 1 0286 2 *
25 010 *C ENDMIN +004 1 ENDREG +004 1 *
25 020 *B CONTCS T*
CONTCI
25 030 CONTCI *A CONC1 WCCT *
25 040 *MA CON4 0089 *
25 050 *MA CON9 0094 *
25 060 *B CONTCF WCCT 9*
1 2 3 4 5 6 7 8 9 10

```
                                                                  1  2  3  4  5  6  7  8  9 10
                                                                  |  |  |  |
                                                                  |  |  |  |
                    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX         A  V  A  V
25 061              *B    CONTDY                          *-------   V  A  V
                    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX            V  A  V
                                                                     V  A  V
                                                                     V  A  V
                                                                     V  A  V
                                                                     V  A  V
                              CONTCG  |-----------------------------   A  V
                                      |                               A  V
                    ************************************              A  V
25 070  CONTCG      *MCW  ASTER          0207        2   *            A  V
25 071              *MCW  ASTER          NOTIND          *            A  V
                    ************************************              A  V
                                      |                               A  V
                                      |                               A  V
                                      |                               A  V
                                      |                               A  V
                    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX            A  V
25 080              *B    CONTCI                          *-------------   V
                    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX                  V
                                                                           V
                                                                           V
                                                                           V
                              CONTCH  |-----------------------------------
                                      |
                    ************************************
25 081  CONTCH      *MCW  FOOT4          0220            *
25 090              *CC                                T*
25 100              *W                                  *
25 110              *CS   0299                          *
                    ************************************
                                      |
                                      |
                                      |
                                      |
                    *************************
                  *                         *
25 120            *B    CONTCJ         NOTIND          **--------
                  *                         *                    V
                    *************************                    V
                                      |                          V
                                      |                          V
                              CONTCK  |--------------------------
                                      |                          V  A
                    ************************************       V  A
25 130  CONTCK      *CC                                1*      V  A
25 140              *MCW  JOBEND         0234            *      V  A
25 150              *W                                  *      V  A
25 160              *CC                                1*      V  A
25 170              *H                                  *      V  A
                    ************************************       V  A
                                      |                       V  A
                                      |                       V  A
                              CONTCJ  |-------------------------   A
                                      |                          A
                    ************************************       A
25 180  CONTCJ      *MCW  NOTE           0265            *      A
25 200              *W                                  *      A
25 210              *CS   0299                          *      A
                    ************************************       A
                                      |                       A
                                      |                       A
                                      |                       A
                                      |                       A
                    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     A
25 220              *B    CONTCK                          *----------
                    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

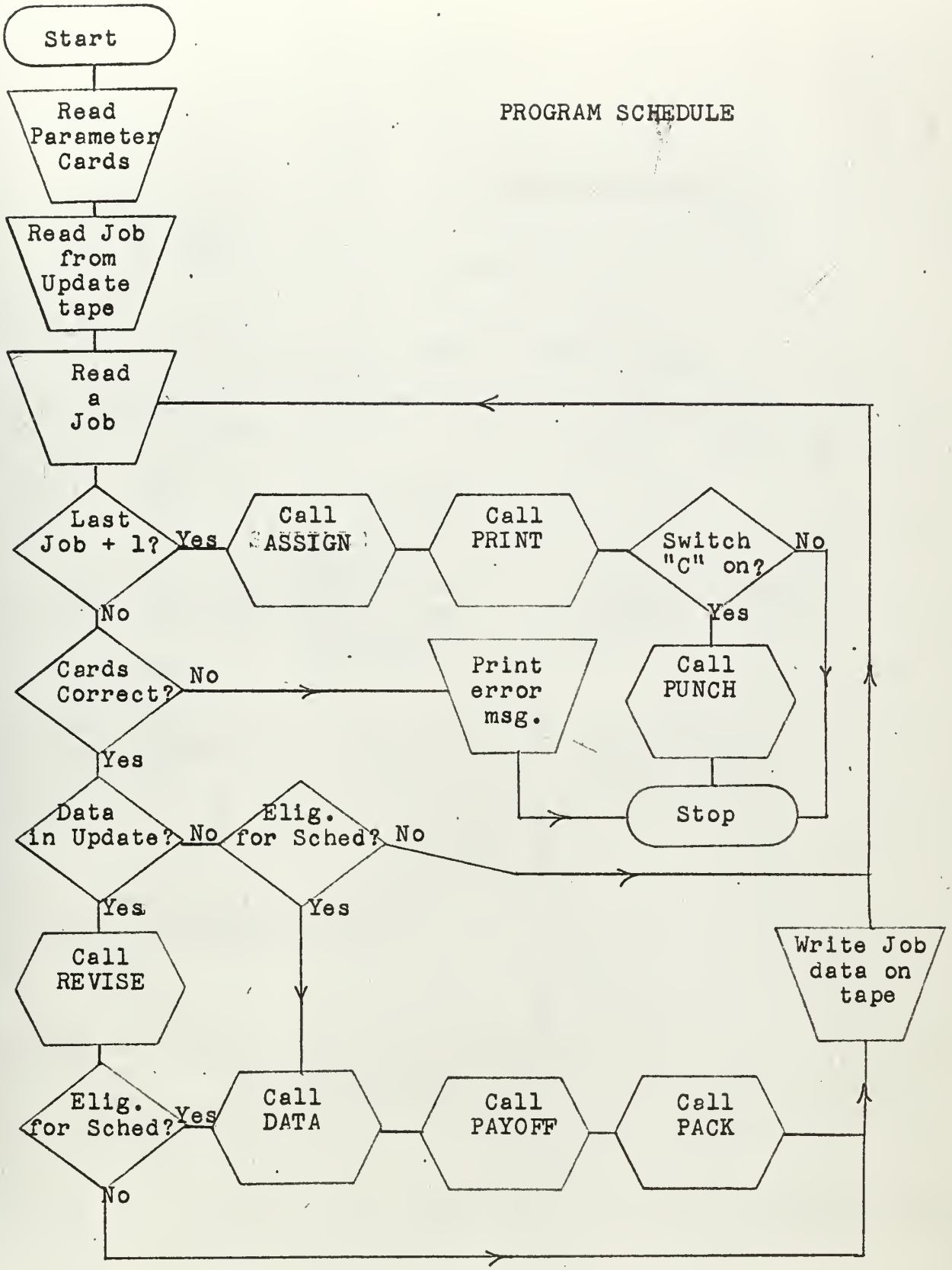
```
26 010  ZERO     DCW *       0000
26 020  CON150   DCW *       150
26 030  ERNOT1   DCW *       A READ-IN ERROR HAS OCCURRED.
26 040           DCW *       AFTER CORRECTION OF THE ERROR, T
26 050           DC  *       HE PROGRAM CAN BE RESTARTED WITH
26 060           DC  *        THE BEGINNING OF THE JOB WHICH
26 070  ERNOT2   DC  *       SHOWED THE ERROR
26 080           DCW *       PLACE IN READ HOPPER, MASTER CAR
26 090  ERNOT3   DC  *       D FIRST, AND PRESS START.
26 100  CON6     DCW *       6
26 110  WCCT     DCW 0334    0
26 120  CON410   DCW *       410
26 130  RECMRK   DCW *       #
26 140  CON52    DCW *       052
26 150  GRPMRK   DCW 0691
```

```
26 160  CON2     DCW *       2
26 170  ASTER    DCW *       *
26 180  REPEAT   DCW 0334    0
26 190  CON9     DCW *       009
26 200  CON01    DCW *       0001
27 010  WORKA    DCW 0344    0000000000
27 020  WORKB    DCW 0348    0000
27 030  WORKC    DCW 0355    0000000
27 040  WORKD    DCW 0367    00000000000
27 050  SLACK    DCW 0376    0
27 060  DAYS     DCW 0377    0
27 070  ENTRY    DCW 0381    0000
27 080  WORKE    DCW 0375    00000000
27 090  PAYOFF   DCW 0385    0000
27 100  CONSNT   DS  0431
27 110  CON635   DCW *       0635
27 120  CON83    DCW *       083
27 130  BLANK    DCW *
27 140  LIMIND   DCW 0386    0
27 150  ENDMIN   DS  0442
27 160  ENDMAX   DS  0474
27 170  ENDREG   DS  0538
27 180  WCMAX    DS  0506
27 190  WCREG    DS  0570
27 200  COUNT1   DCW 0389    000
27 210  DASHES   DCW *        --
27 220  CON78    DCW *       78
27 230  NOTIND   DCW 0397    0
27 240  DATE     DS  0425
27 250  UPDATE   DS  0610
27 260  TEMP     DS  0700
28 010  COUNT2   DCW 0392    000
28 020  HCOUNT   DCW 0396    0000
28 030  FUND     DCW 0398    0
28 040  FIN      DCW *       FIN
28 050  CON4     DCW *       004
28 060  WAIT     DCW 0605    000
28 070  CON8     DCW *       008
28 080  CON3     DCW *       3
28 081  TENT     DCW *       TENTATIVE
28 090           DCW *       SHOP WORK SCHEDULE FOR THE WEEK
28 100  HEAD1    DC  *       ENDING
28 110  HEAD3    DCW *       PAGE NO.
28 120  HEAD4    DCW *       UNITS = MANHOURS
28 130           DCW *       JOB   FUND  PAYOFF  SHOP 1   SHO
28 140           DC  *       P 2   SHOP 3   SHOP 4   SHOP 5
28 150  HEAD2    DC  *        SHOP 6   SHOP 7   SHOP 8
28 160           DCW *       FUND SOURCES    1        2
28 170           DC  *         3        4        5        6
28 180  FOOT1    DC  *             7        8
```

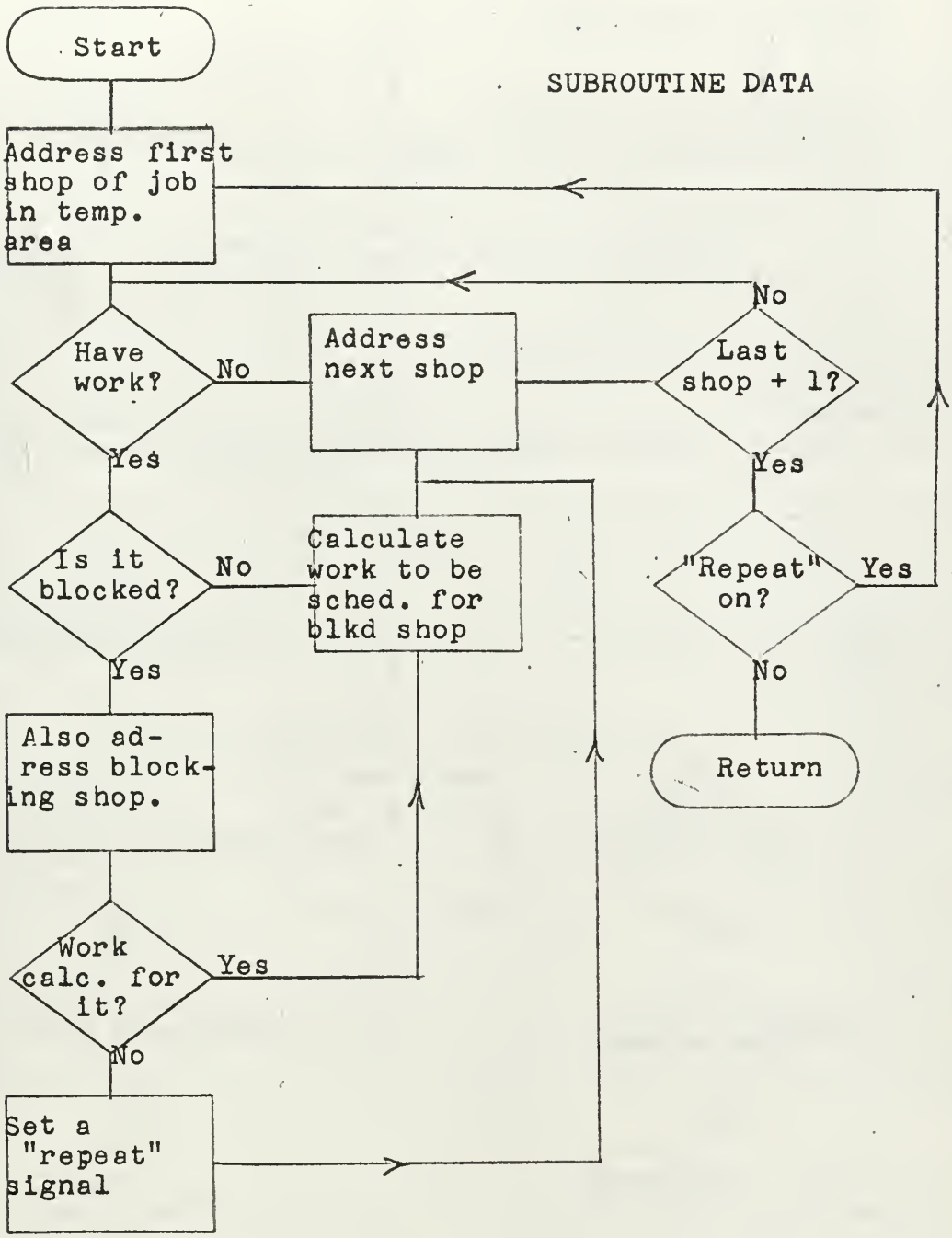
```
28 190  FOOT4   DCW *       MANHOUR TOTALS =
28 200          DCW *       * = INSUFFICIENT ACTIVATED WORK
28 210  NOTE    DC  *       TO MEET SPECIFIED REQUIREMENTS
28 220  LINECT  DCW 0607    00
28 230  PAGECT  DCW 0609    01
28 240  JOBEND  DCW *       JOB COMPLETED
28 250  TABLE   DS  5500

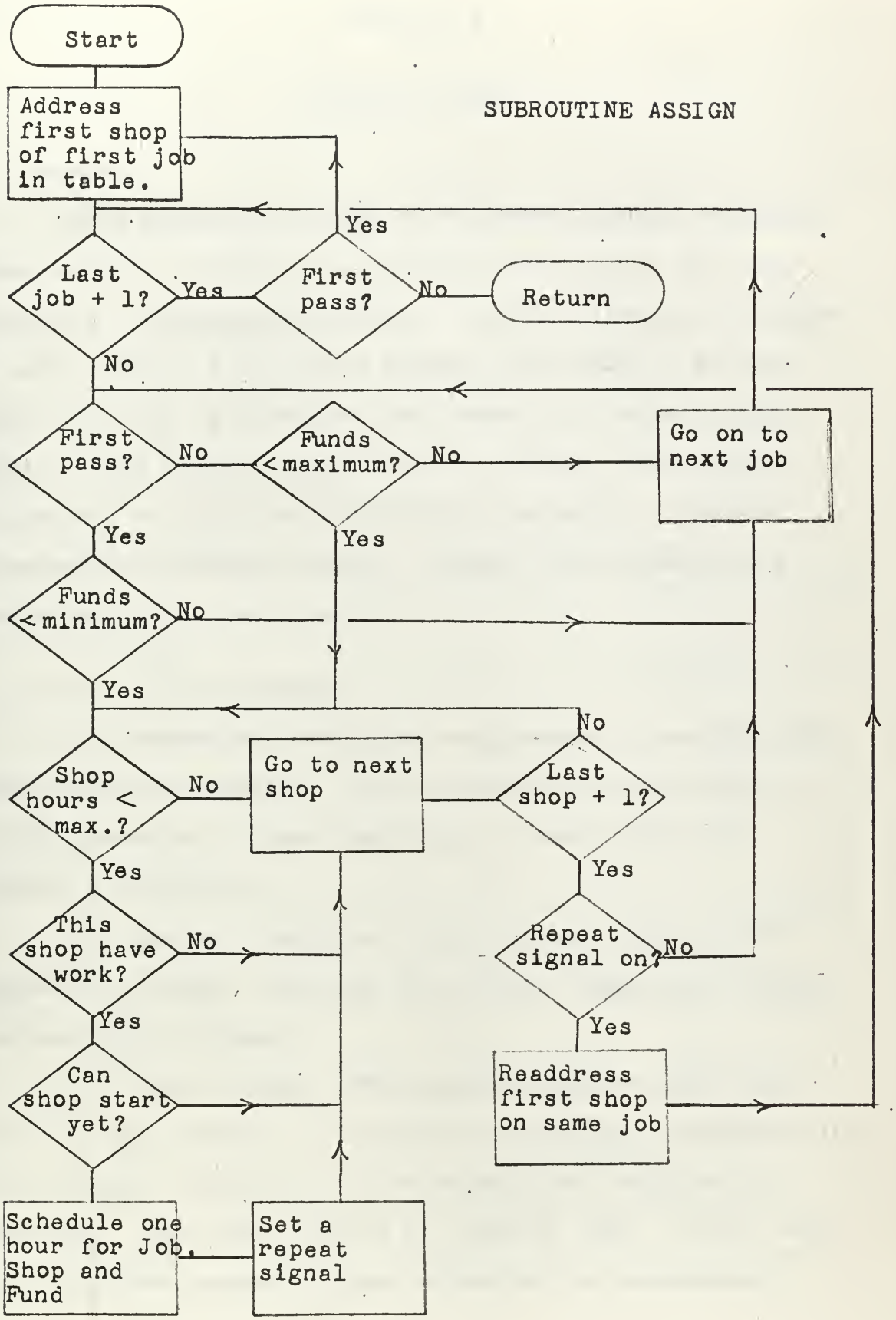
28 260          *END  START
```

PROGRAM SCHEDULE






Start
SUBROUTINE DATA
Address first shop of job in temp. area
Have work?
No
Address next shop
Last shop + 1?
No
Yes
Yes
Is it blocked?
No
Calculate work to be sched. for blkd shop
"Repeat" on?
Yes
Yes
No
Also address blocking shop.
Return
Work calc. for it?
Yes
No
Set a "repeat" signal


SUBROUTINE ASSIGN
Start
Address first shop of first job in table.
Last job + 1?
Yes
First pass?
No
Return
Yes
No
First pass?
No
Funds < maximum?
No
Go on to next job
Yes
Yes
Funds < minimum?
No
Yes
No
Shop hours < max.?
No
Go to next shop
Last shop + 1?
Yes
Yes
This shop have work?
No
Repeat signal on?
No
Yes
Yes
Can shop start yet?
Readdress first shop on same job
Schedule one hour for Job, Shop and Fund
Set a repeat signal



APPENDIX B

PROGRAM REPORT

I. General

This program, written in the SPS language, prepares three printed reports of maintenance work under the cognizance of the Autosked system. The Job Listing is printed as data cards are processed through the reader. At the same time data is extracted and stored in a core storage table. Upon completion of the Job Listing, this data is called out to print the Work Backlog reports. A general discussion of program inputs, outputs, and operation is contained in the basic text.

II. Machine Requirements

A. Hardware. The basic requirement is an IBM 1401 data processing system. The processing unit must have a 16,000 character storage capacity. A read-punch and printer are required.

B. Special features. In addition to the 16,000 character storage, the high, low, equal compare and indexing features are used.

C. Core storage. The program requires 3295 positions of core storage. In addition, each job considered in the backlog is entered in core storage and requires 50 positions. The table starts at position 4000. Thus, 240 is the maximum number of jobs which can be accomodated.

III. Processing

A condensed program deck precedes the Library Deck in the read hopper. Stops occur if cards are detected out of sequence and a message giving the source of the error is printed. Completion of the job is signaled by a printed message.

IV. Card Deck Preparation

The Library Deck is processed as maintained. A Date Card, punched as follows, must precede the Library Deck:

Card Columns	Description
1	The letter "D" to identify the card as a Date Card
2-18	The calendar date the report is prepared (e.g., 18 May 1965)

A blank card is required behind the Library Deck to signal the end of the data.

V. Block Diagram

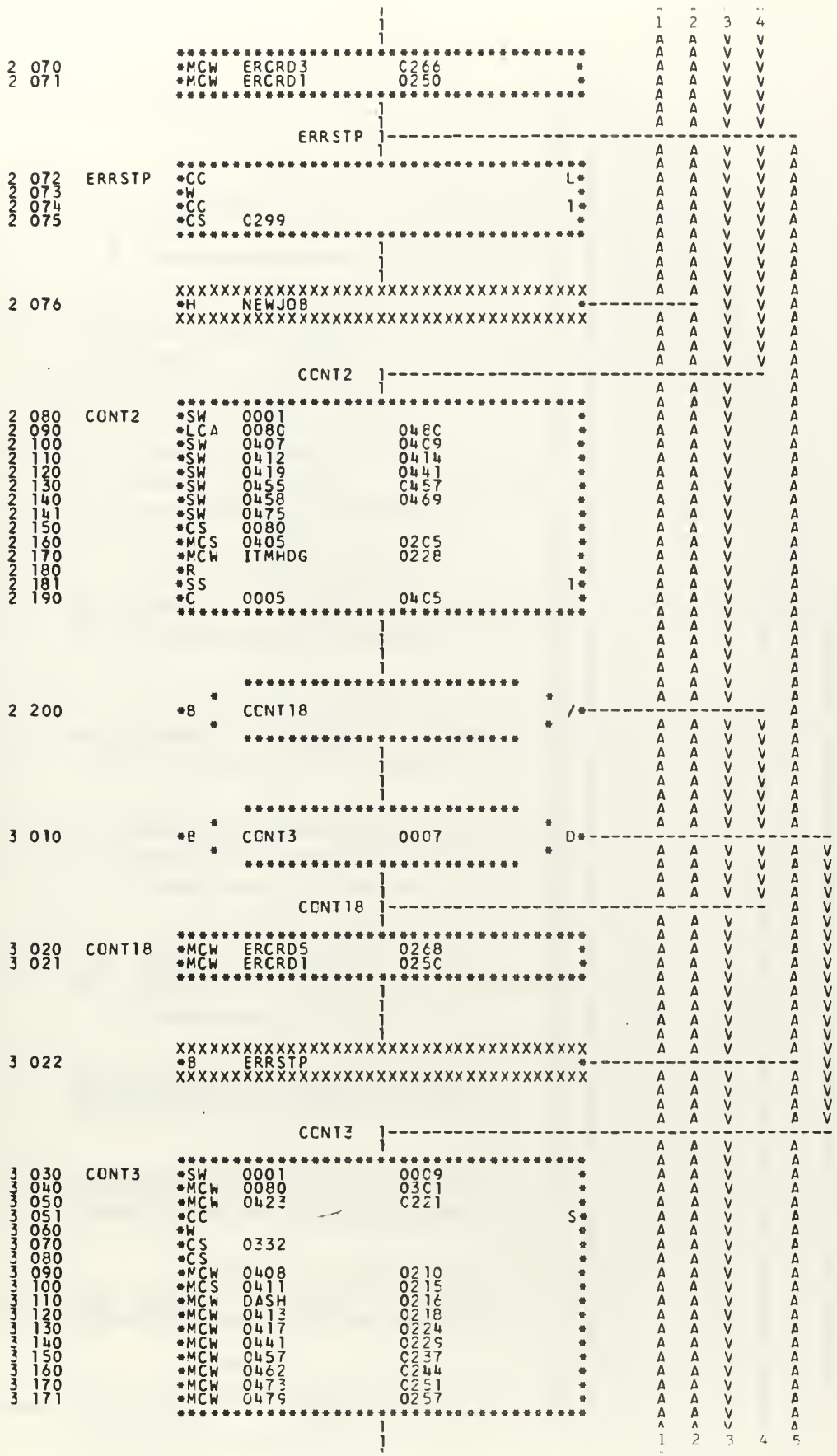
The block diagram which follows depicts the program logic and also serves as a SPS program listing. The glossary preceding the diagram identifies the labels used. A flow chart of general program logic follows the block diagram.

Label	Definition
ACON_	Constant used for address modification
ACTIND	Signal to indicate which backlog report is being prepared

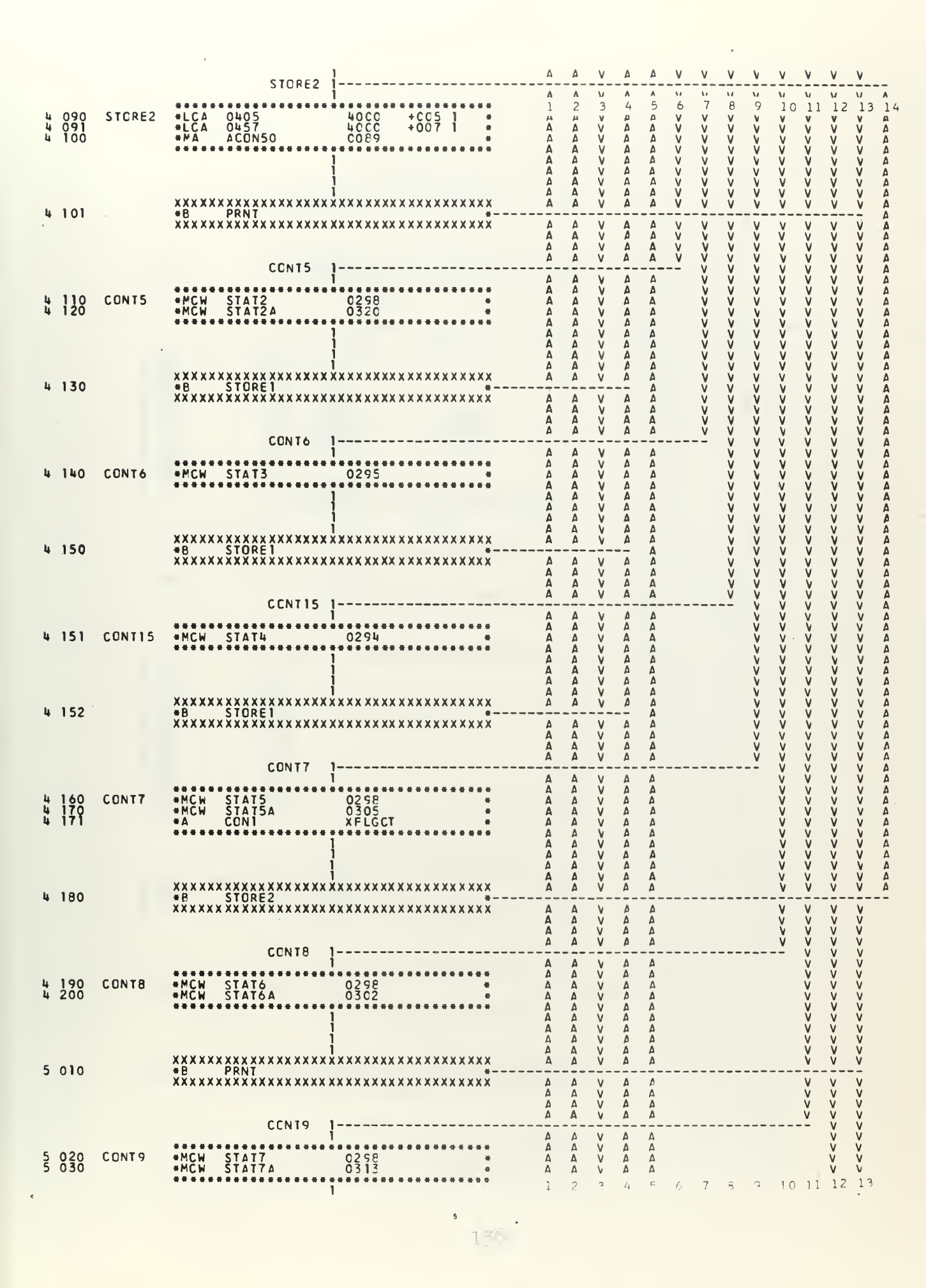
Label	Definition
ASTER	An asterisk
COLHD_	Alphanumeric column headings for Job Listing
CON___	Numeric constant
CONHDG	Job Listing heading
CONT__	Jump in the program
DASH(ES)	Dash(es) used in print-out and as a signal
DATE	The calendar date
EMPTY	Field of 4 blanks
ERCRD_	Error messages
ERRSTP	The error stop routine
FLAGCT	Counter of the number of activated jobs
FNDCOD	A sorter counter for fund sources
ITMHDG	A header for Job Listing
JOBEND	"Job Completed" message
LINECT	Count of lines used on a page
NEWJOB	Beginning of processing for each job
NEWPG1	Start new page of Job Listing
NEWPG2	Start new page of Backlog Report
PAGECT	Page counter
PAGEHDG	Heading for page number
PRNT	Beginning of routine to print a line of Job Listing
PRNTCT	Counter of the number of jobs listed
REPFT_	Alphanumeric footings for Backlog Reports
REPHD_	Alphanumeric headings for Backlog Reports

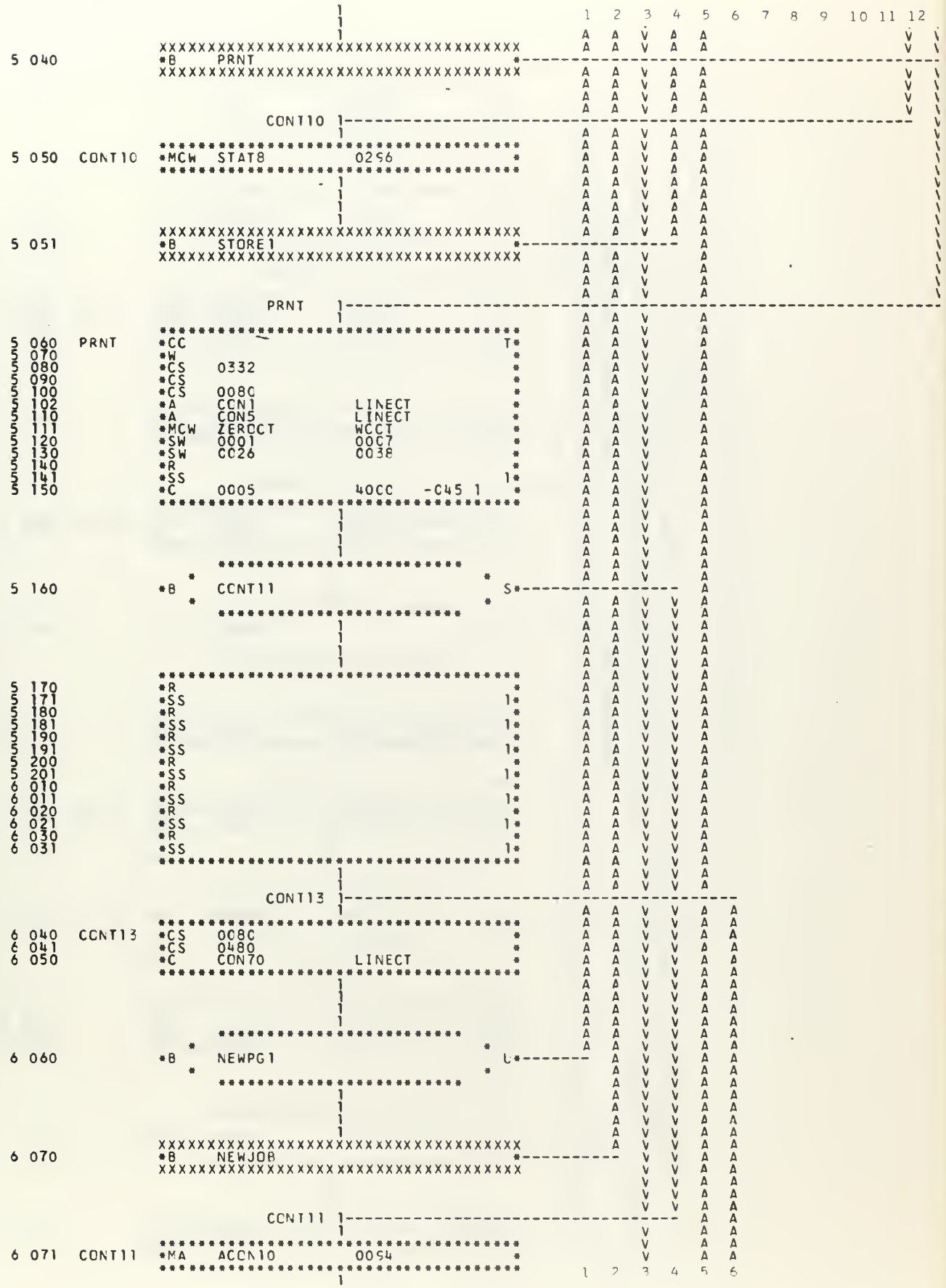
Label	Definition
STAT__	Alphanumeric description of job status
STORE_	Active/inactive identification routines
WCCT	Work center sorting counter
XFLGCT	Count of "not activated" jobs
ZEROCT	Field of 3 zeros

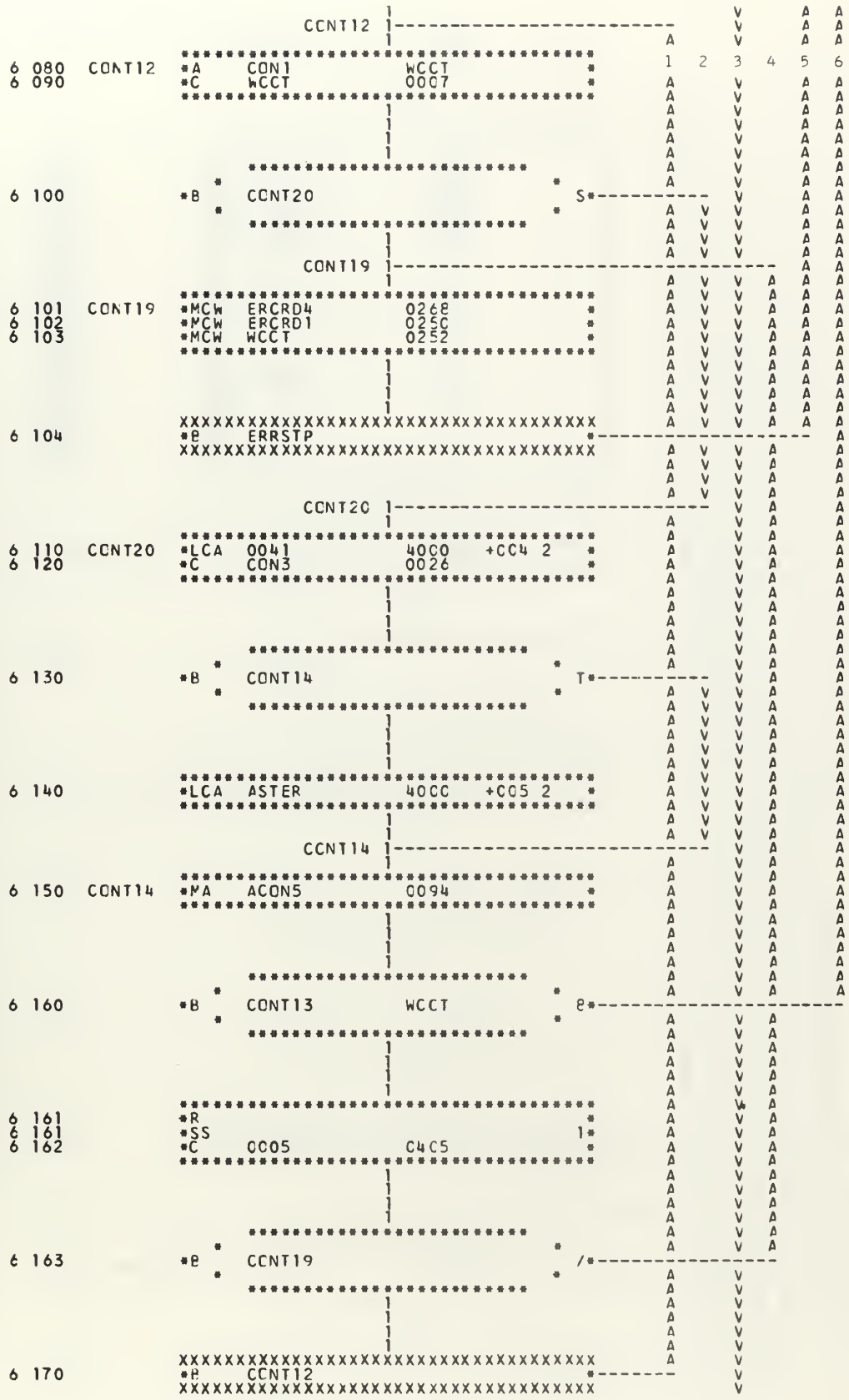

PG LIN LABEL OP A ADJ XR B ADJ XR C
1 010 *CTL 66
1 011 *CRG 0600
START
1 020 START *R
1 021 *SS 1*
1 030 *B CONT1 COC1 D*
1 040 *MCW ERCRD2 0260
1 041 *MCW ERCRD1 0250
1 042 *CC L*
1 043 *W
1 044 *CS 0080
1 045 *CC 1*
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1 046 *H START
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
CONT1
1 050 CONT1 *SW 0002
1 060 *LCA 0018 DATE
1 061 *CS 0080
NEWPG1
1 080 NEWPG1 *CC 1*
1 081 *A CON1 PAGECT
1 090 *MCW CONHDG 0241
1 100 *MCW DATE 0258
1 110 *MCW PAGHDG 0313
1 120 *MCS PAGECT 0315
1 130 *CC T*
1 140 *W
1 150 *CS 0332
1 160 *CS
1 170 *MCW COLHD1 0239
1 180 *MCW COLHD2 0263
1 190 *MCW COLHD3 0290
1 200 *CC T*
2 010 *W
2 020 *CS 0299
2 030 *MCW ZEROCT LINECT
NEWJOB
2 040 NEWJOB *R
2 041 *SS 1*
2 050 *B CONTJ 0005
2 060 *B CONT2 CCBC 1*
1 2 3 4

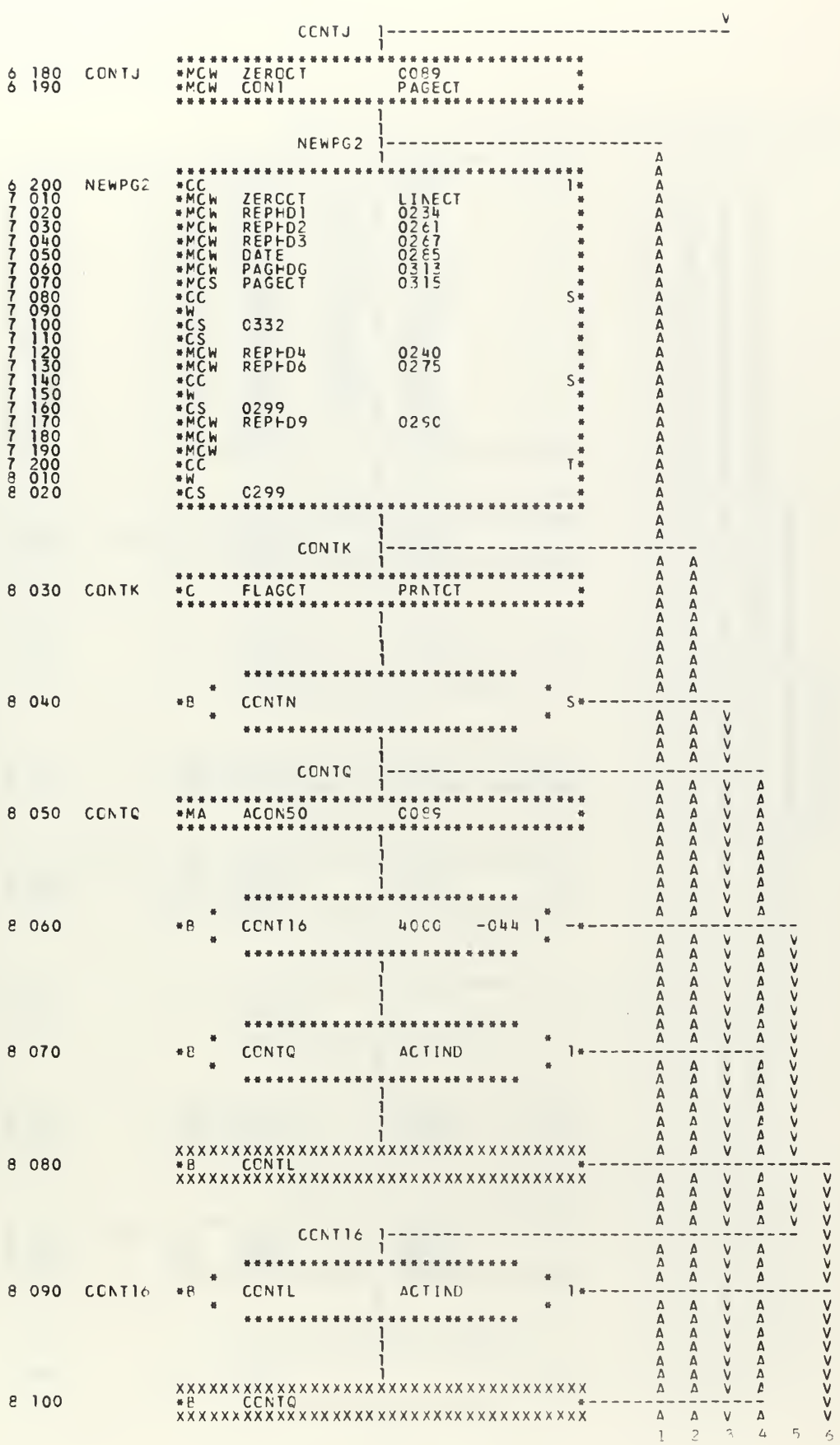

ERRSTP
CONT2
CONT18
CONT3
2 070 *MCW ERCRD3 C266
2 071 *MCW ERCRD1 0250
2 072 ERRSTP *CC L
2 073 *W
2 074 *CC 1
2 075 *CS C299
2 076 *H NEWJOB
2 080 CONT2 *SW 0001
2 090 *LCA 0080 048C
2 100 *SW 0407 04C9
2 110 *SW 0412 0414
2 120 *SW 0419 0441
2 130 *SW 0455 C457
2 140 *SW 0458 0469
2 141 *SW 0475
2 150 *CS 0080
2 160 *MCS 0405 02C5
2 170 *MCW ITMHDG 0228
2 180 *R
2 181 *SS 1
2 190 *C 0005 04C5
2 200 *B CONT18
3 010 *B CONT3 0007 D
3 020 CONT18 *MCW ERCRD5 0268
3 021 *MCW ERCRD1 025C
3 022 *B ERRSTP
3 030 CONT3 *SW 0001 0009
3 040 *MCW 0080 03C1
3 050 *MCW 0423 C221
3 051 *CC S
3 060 *W
3 070 *CS 0332
3 080 *CS
3 090 *MCW 0408 0210
3 100 *MCS 0411 0215
3 110 *MCW DASH 0216
3 120 *MCW 0413 0218
3 130 *MCW 0417 0224
3 140 *MCW 0441 0229
3 150 *MCW 0457 0237
3 160 *MCW 0462 C244
3 170 *MCW 0473 C251
3 171 *MCW 0479 0257
1 2 3 4
1 2 3 4 5

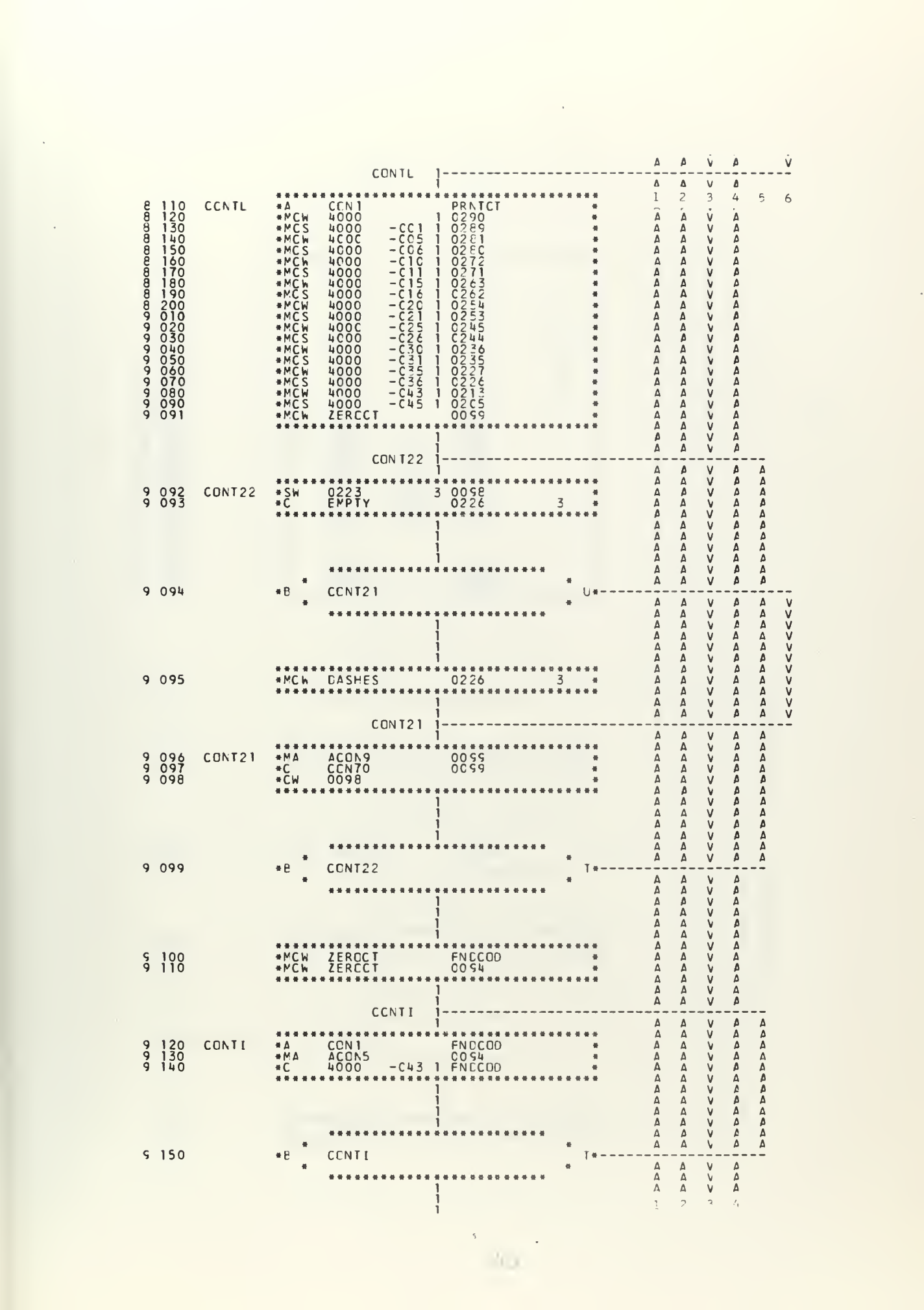
3 180 *B CONT4 0455
3 190 *B CONT5 0455
3 200 *B CONT6 0455
3 201 *B CONT15 0455
4 010 *B CONT7 0455
4 020 *B CONT8 0455
4 030 *B CONT9 0455
4 040 *B CONT10 0455
4 050 *MCW STAT9 0297
4 060 *B PRNT
CONT4
4 070 CONT4 *MCW STAT1 0292
STORE1
4 080 STORE1 *LCA DASH 400C +006 1
4 081 *A CCN1 FLAGCT
1 2 3 4 5 6 7 8 9 10 11 12 13

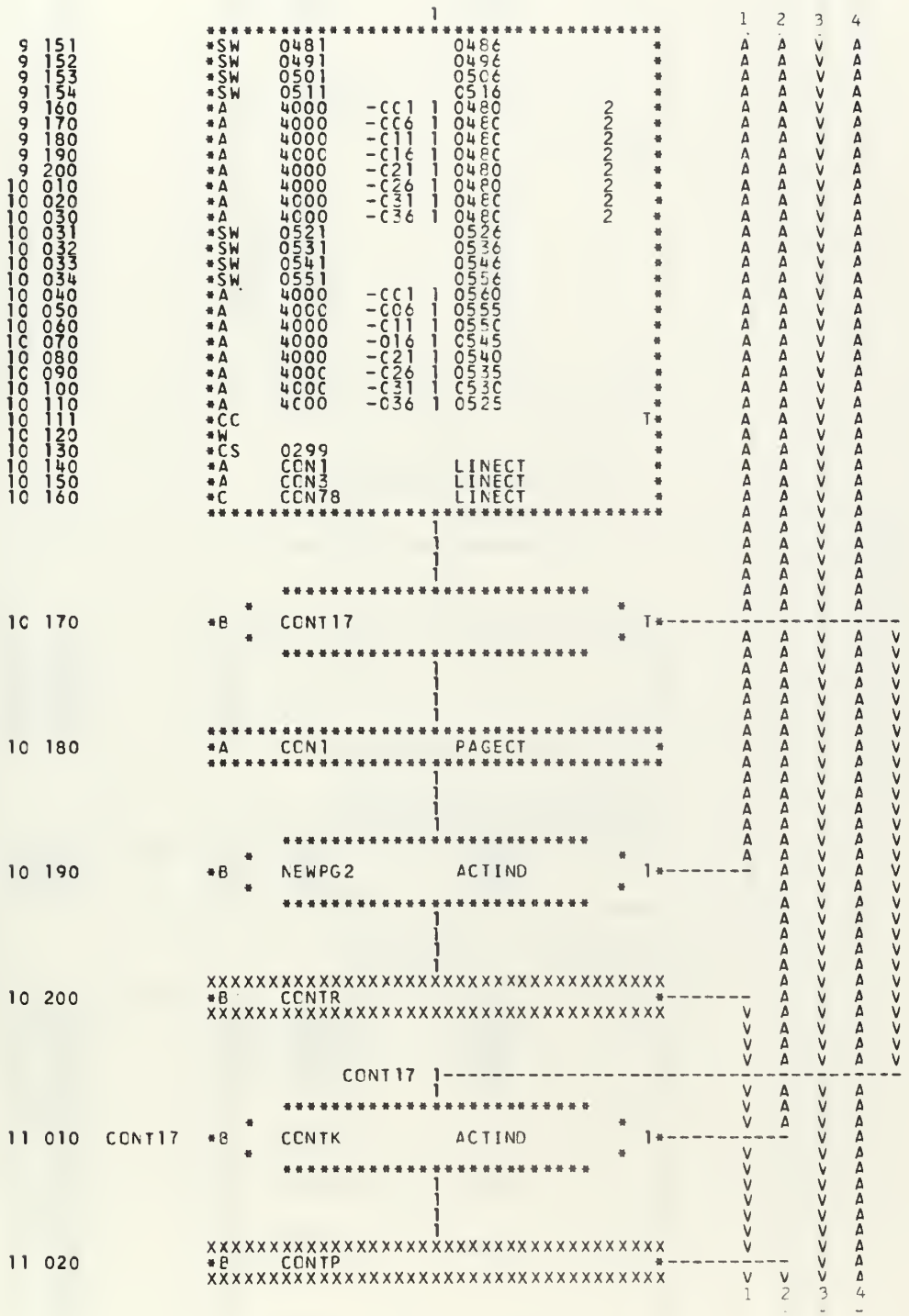

STORE2
4 090 STORE2 *LCA 0405 40C0 +C05 1 *
4 091 *LCA 0457 40CC +007 1 *
4 100 *MA ACON50 C089 *
4 101 *B PRNT *
CONT5
4 110 CONT5 *MCW STAT2 0298 *
4 120 *MCW STAT2A 0320 *
4 130 *B STORE1 *
CONT6
4 140 CONT6 *MCW STAT3 0295 *
4 150 *B STORE1 *
CONT15
4 151 CONT15 *MCW STAT4 0294 *
4 152 *B STORE1 *
CONT7
4 160 CONT7 *MCW STAT5 0298 *
4 170 *MCW STAT5A 0305 *
4 171 *A CON1 XFLGCT *
4 180 *B STORE2 *
CONT8
4 190 CONT8 *MCW STAT6 0298 *
4 200 *MCW STAT6A 0302 *
5 010 *B PRNT *
CONT9
5 020 CONT9 *MCW STAT7 0298 *
5 030 *MCW STAT7A 0313 *

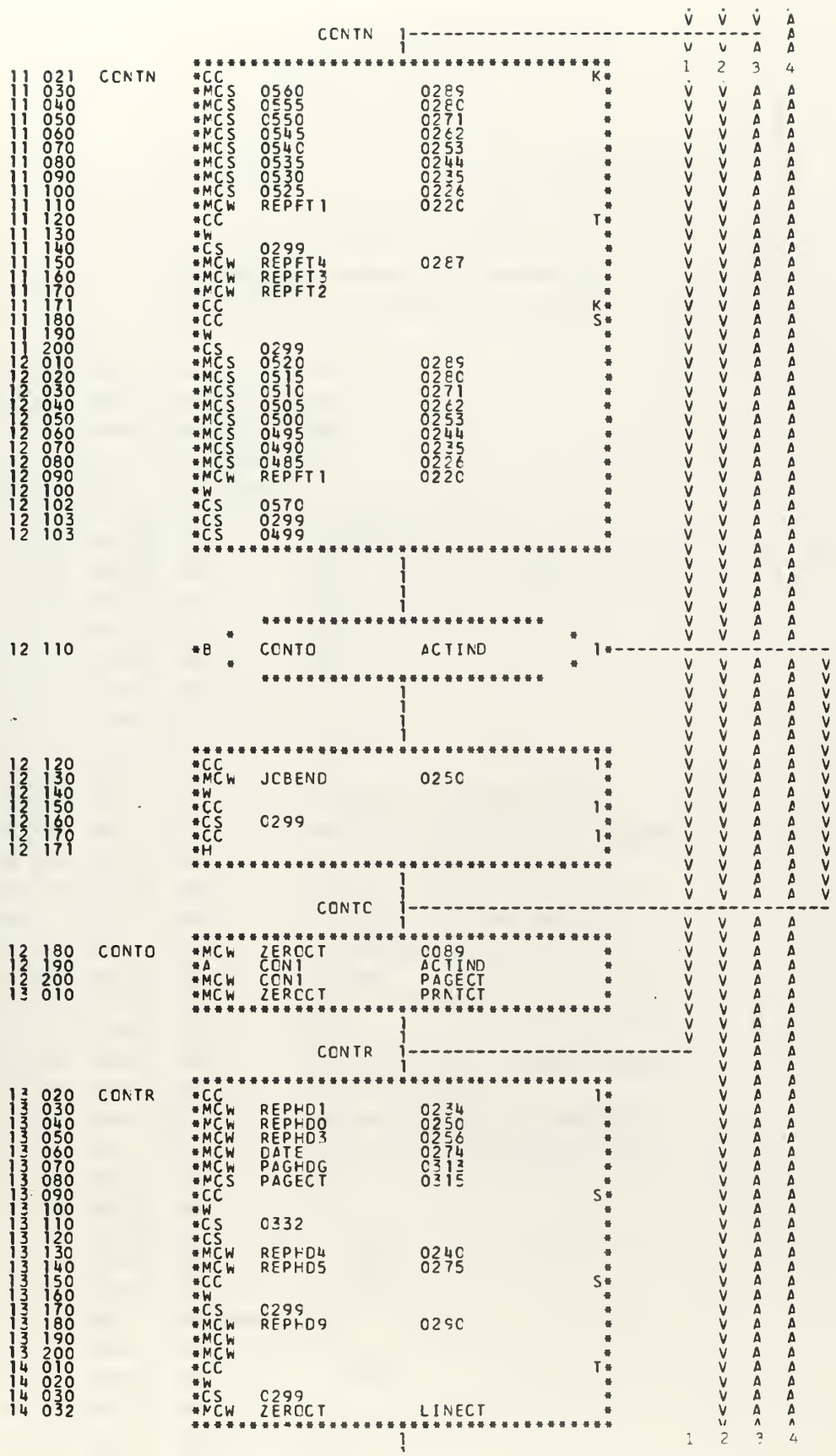

1 2 3 4 5 6 7 8 9 10 11 12
5 040 *B PRNT
CONT10
5 050 CONT10 *MCW STAT8 0296
5 051 *B STORE1
PRNT
5 060 PRNT *CC T*
5 070 *W *
5 080 *CS 0332 *
5 090 *CS *
5 100 *CS 008C *
5 102 *A CCN1 LINECT *
5 110 *A CON5 LINECT *
5 111 *MCW ZEROCT WCCT *
5 120 *SW 0001 00C7 *
5 130 *SW CC26 0038 *
5 140 *R *
5 141 *SS 1*
5 150 *C 0005 40CC -C45 1 *
5 160 *B CCNT11 S*
5 170 *R *
5 171 *SS 1*
5 180 *R *
5 181 *SS 1*
5 190 *R *
5 191 *SS 1*
5 200 *R *
5 201 *SS 1*
6 010 *R *
6 011 *SS 1*
6 020 *R *
6 021 *SS 1*
6 030 *R *
6 031 *SS 1*
CONT13
6 040 CCNT13 *CS 008C *
6 041 *CS 0480 *
6 050 *C CON70 LINECT *
6 060 *B NEWPG1 L*
6 070 *B NEWJOB
CCNT11
6 071 CONT11 *MA ACCN10 0094 *
1 2 3 4 5 6

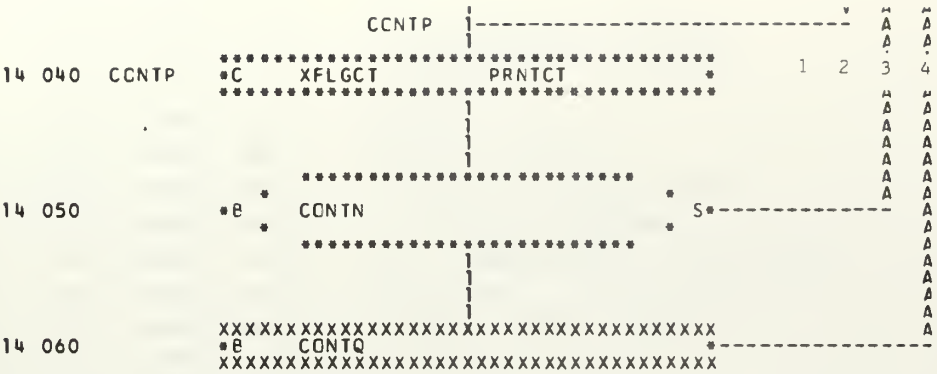

CONT12
6 080 CONT12 *A CON1 WCCT *
6 090 *C WCCT 0007 *
6 100 *B CONT20 S*
CONT19
6 101 CONT19 *MCW ERCRD4 0268 *
6 102 *MCW ERCRD1 025C *
6 103 *MCW WCCT 0252 *
6 104 *B ERRSTP *
CONT20
6 110 CONT20 *LCA 0041 40C0 +CC4 2 *
6 120 *C CON3 0026 *
6 130 *B CONT14 T*
CONT14
6 140 *LCA ASTER 40CC +CC5 2 *
6 150 CONT14 *MA ACON5 0094 *
6 160 *B CONT13 WCCT @*
6 161 *R *
6 161 *SS 1*
6 162 *C 0005 C4C5 *
6 163 *B CONT19 /*
6 170 *B CONT12 *
1 2 3 4 5 6
1 2 3


CONTJ
6 180 CONTJ *MCW ZEROCT C089 *
6 190 *MCW CON1 PAGECT *
NEWPG2
6 200 NEWPG2 *CC 1*
7 010 *MCW ZEROCT LINECT *
7 020 *MCW REPHD1 0234 *
7 030 *MCW REPHD2 0261 *
7 040 *MCW REPHD3 0267 *
7 050 *MCW DATE 0285 *
7 060 *MCW PAGHDG 0312 *
7 070 *MCS PAGECT 0315 *
7 080 *CC S*
7 090 *W *
7 100 *CS 0332 *
7 110 *CS *
7 120 *MCW REPHD4 0240 *
7 130 *MCW REPHD6 0275 *
7 140 *CC S*
7 150 *W *
7 160 *CS 0299 *
7 170 *MCW REPHD9 029C *
7 180 *MCW *
7 190 *MCW *
7 200 *CC T*
8 010 *W *
8 020 *CS 0299 *
CONTK
8 030 CONTK *C FLAGCT PRNTCT *
8 040 *B CONTN S*
CONTQ
8 050 CONTQ *MA ACONSO C099 *
8 060 *B CONT16 40CC -044 1*
8 070 *B CONTQ ACTIND 1*
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
8 080 *B CONTL *
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
CONT16
8 090 CONT16 *B CONTL ACTIND 1*
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
8 100 *B CONTQ *
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
1 2 3 4 5 6


CONTL
8 110 CONTL *A CCN1 PRNTCT
8 120 *MCW 4000 1 0290
8 130 *MCS 4000 -CC1 1 0289
8 140 *MCW 4C0C -C05 1 0281
8 150 *MCS 4000 -C06 1 028C
8 160 *MCW 4000 -C10 1 0272
8 170 *MCS 4000 -C11 1 0271
8 180 *MCW 4000 -C15 1 0263
8 190 *MCS 4000 -C16 1 C262
8 200 *MCW 4000 -C20 1 0254
9 010 *MCS 4000 -C21 1 0253
9 020 *MCW 400C -C25 1 0245
9 030 *MCS 4C00 -C26 1 C244
9 040 *MCW 4000 -C30 1 0236
9 050 *MCS 4000 -C31 1 0235
9 060 *MCW 4000 -C35 1 0227
9 070 *MCS 4000 -C36 1 0226
9 080 *MCW 4000 -C43 1 0213
9 090 *MCS 4000 -C45 1 02C5
9 091 *MCW ZERCCT 0099
CONT22
9 092 CONT22 *SW 0223 3 0098
9 093 *C EMPTY 0226 3
9 094 *B CCNT21 U
9 095 *MCW DASHES 0226 3
CONT21
9 096 CONT21 *MA ACON9 0099
9 097 *C CCN70 0099
9 098 *CW 0098
9 099 *B CONT22 T
S 100 *MCW ZEROCT FNDCOD
9 110 *MCW ZERCCT 0094
CCNTI
9 120 CONTI *A CCN1 FNDCOD
9 130 *MA ACON5 0094
9 140 *C 4000 -C43 1 FNDCOD
S 150 *B CCNTI T


9 151 *SW 0481 0486
9 152 *SW 0491 0496
9 153 *SW 0501 0506
9 154 *SW 0511 0516
9 160 *A 4000 -CC1 1 0480 2
9 170 *A 4000 -CC6 1 048C 2
9 180 *A 4000 -C11 1 048C 2
9 190 *A 4000 -C16 1 048C 2
9 200 *A 4000 -C21 1 0480 2
10 010 *A 4000 -C26 1 0480 2
10 020 *A 4000 -C31 1 048C 2
10 030 *A 4000 -C36 1 048C 2
10 031 *SW 0521 0526
10 032 *SW 0531 0536
10 033 *SW 0541 0546
10 034 *SW 0551 0556
10 040 *A 4000 -CC1 1 0560
10 050 *A 4000 -C06 1 0555
10 060 *A 4000 -C11 1 055C
10 070 *A 4000 -016 1 0545
10 080 *A 4000 -C21 1 0540
10 090 *A 400C -C26 1 0535
10 100 *A 400C -C31 1 C53C
10 110 *A 4C00 -036 1 0525
10 111 *CC T
10 120 *W
10 130 *CS 0299
10 140 *A CCN1 LINECT
10 150 *A CCN3 LINECT
10 160 *C CCN78 LINECT
1 2 3 4
1
1C 170 *B CONT17 T
10 180 *A CCN1 PAGECT
10 190 *B NEWPG2 ACTIND 1
10 200 *B CCNTR
CONT17 1
11 010 CONT17 *B CCNTK ACTIND 1
11 020 *B CONTP
1 2 3 4

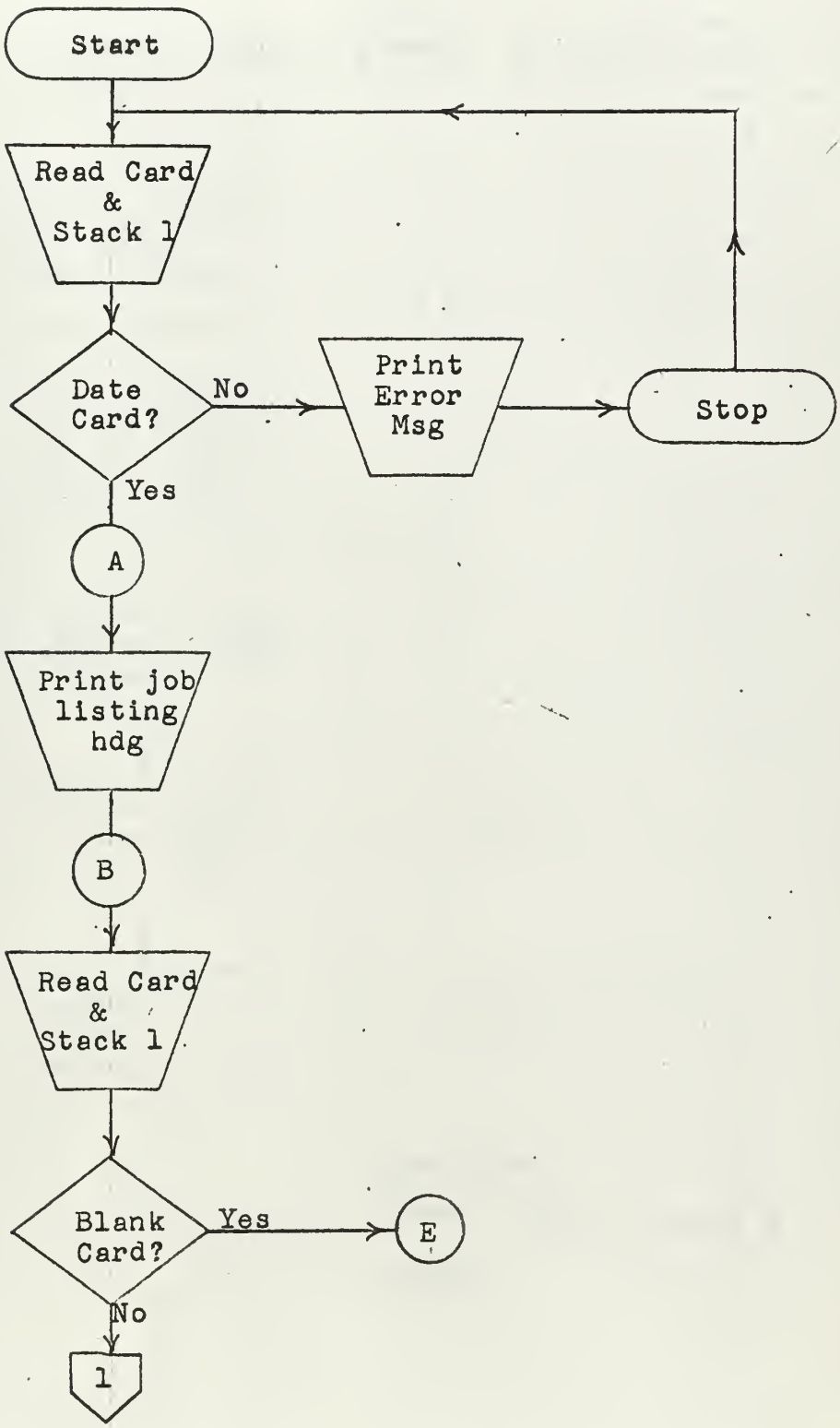

CONTN
CONTN
CONTO
CONTC
CONTR

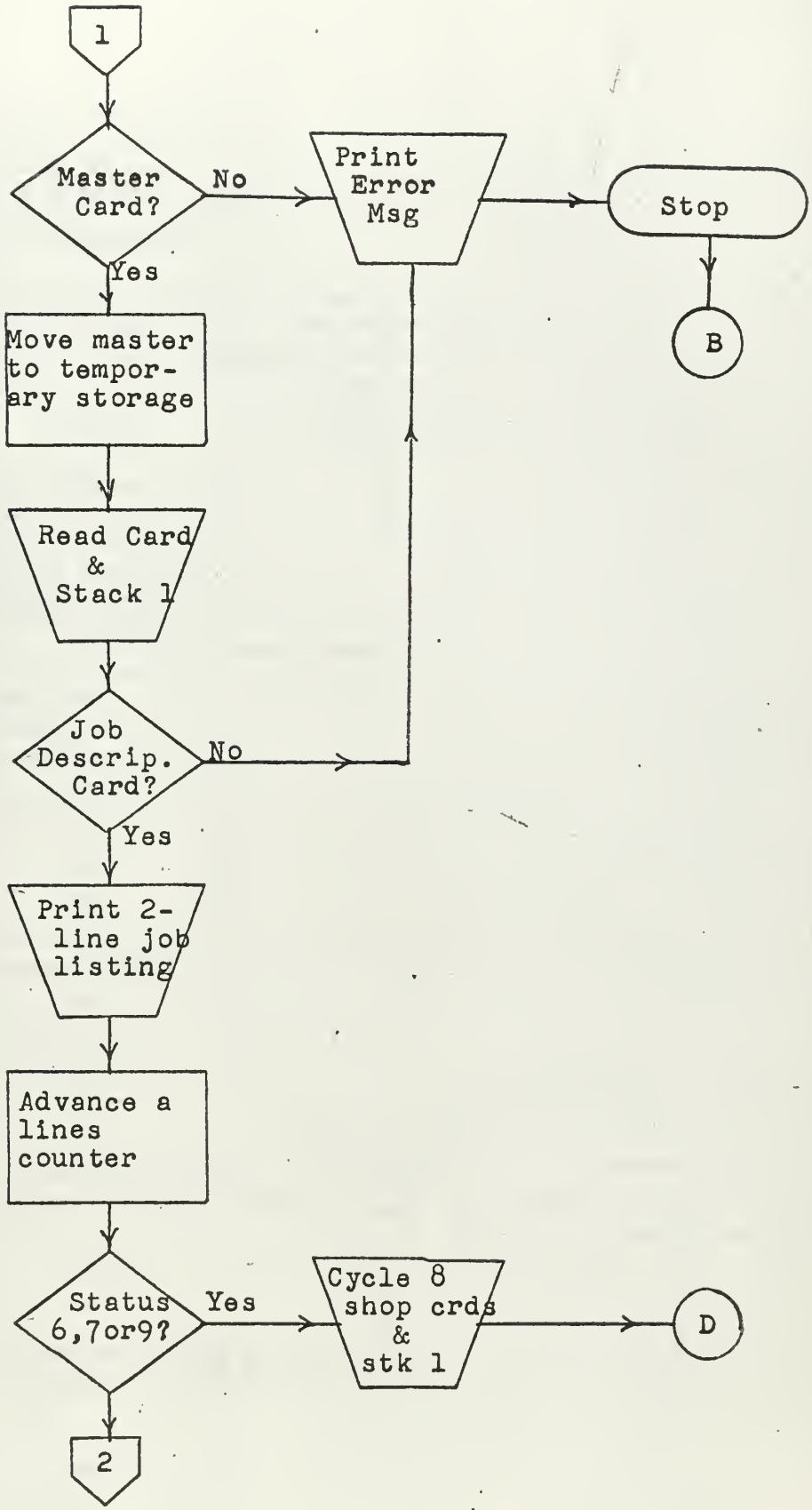


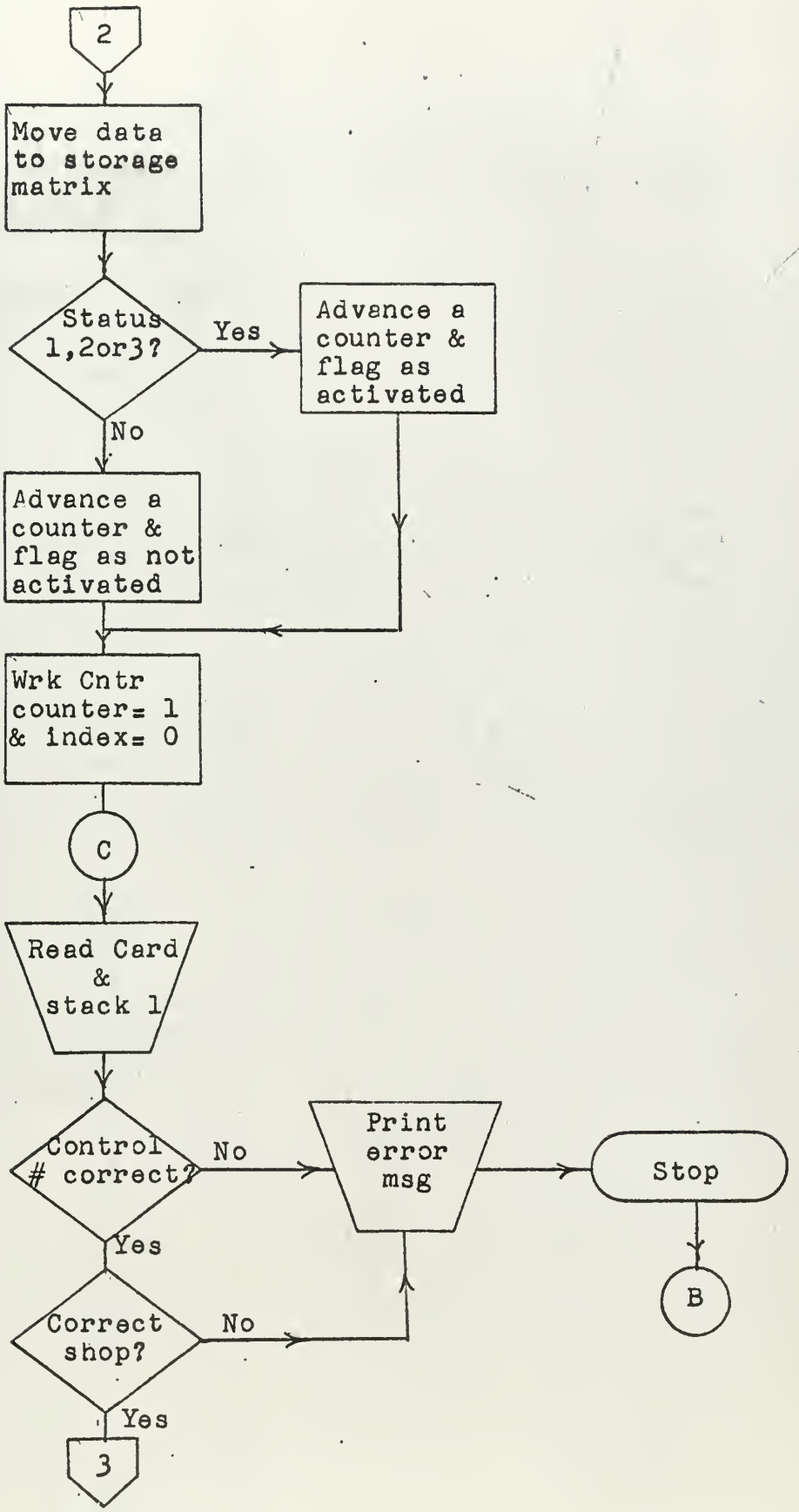

```
15 010  CON1     DCW *       001
15 020  PAGECT   DCW 0351    00
15 030  FLAGCT   DCW 0356    000
15 040  XFLGCT   DCW 0361    000
15 050  DATE     DS  0349
15 060  CONHDG   DCW *       JOB LISTING--CONTRCL NO. AS OF
15 070  PAGHDG   DCW *       PAGE NO.
15 080  COLHD1   DCW *       ORIG.  NO.   DATE  PRIOR.  FUND
15 090  COLHD2   DCW *        JOB   RELATED CNTL NOS.
15 100  COLHD3   DCW *       STATUS
15 110  ZERCCT   DCW *       000
15 120  LINECT   DCW 0365    00
15 130  DASH     DCW *       -
15 140  ITMHDG   DCW *       FACILITY=        JCB=
15 150  CON5     DCW *       5
15 180  STAT1    DCW *       SCHEDULED JCB CURRENT WEEK
15 190  STAT2    DCW *       PREVIOUSLY SCHEDULED BUT DEFERRE
15 200  STAT2A   DCW *       D FCR MORE URGENT WCRK
16 010  STAT3    DCW *       ACTIVATED AWAITING SCHEDULING
16 011  STAT4    DCW *       ACTIVATED, AWAITING MATERIAL
16 020  STAT5    DCW *       IN APPRCVED BACKLCG AWAITING ACT
16 030  STAT5A   DCW *       IVATICN
16 040  STAT6    DCW *       PENDING APPROVAL CF HIGHER AUTHO
16 050  STAT6A   DCW *       RITY
16 060  STAT7    DCW *       REIMBURSABLE WORK PENDING APPROV
16 070  STAT7A   DCW *       AL CF REQUESTOR
16 080  STAT8    DCW *       DEFERRED PENDING JCB AMENDMENT
16 090  STAT9    DCW *       DEFERRED BY MAINTENANCE OFFICER
16 100  CON70    DCW *       70
16 101  CON78    DCW *       78
16 120  ACON50   DSA *           0050
16 130  ACCN10   DSA *           C010
16 131  ACCN9    DSA *           CC09
16 140  WCCT     DCW 0368    0
16 150  CON3     DCW *       3
16 160  ACCN5    DSA *           C005
16 170  ASTER    DCW *       *
16 171  DASHES   DCW *        --
16 172  EMPTY    DCW *       0C0C
16 180  ACTIND   DCW 0371    1
```

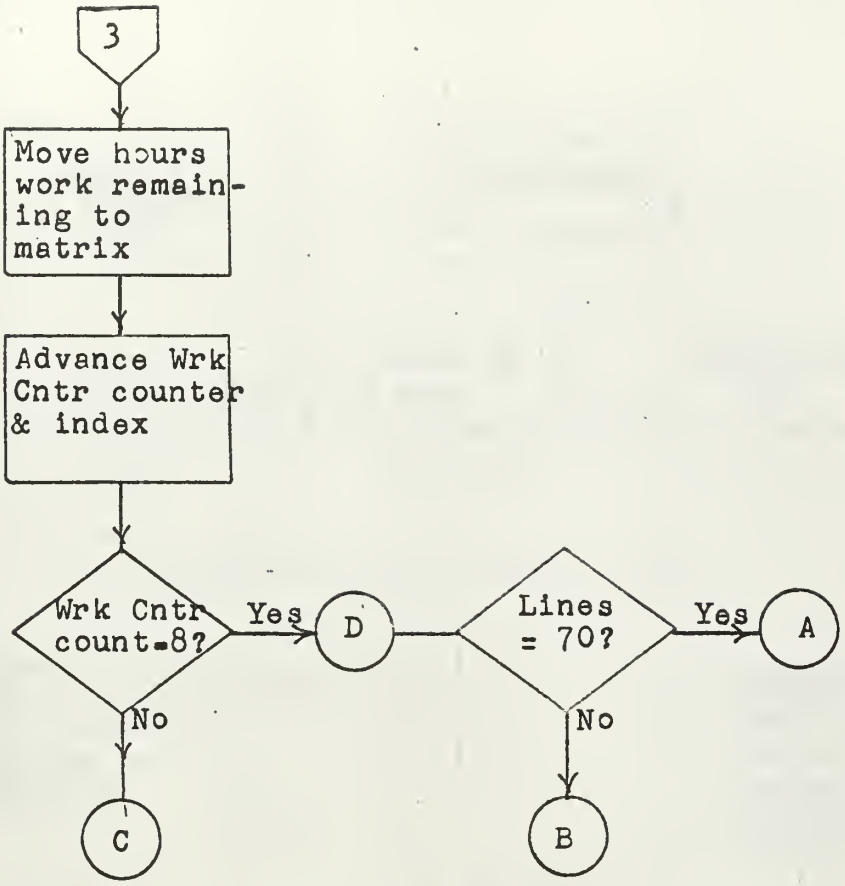
```
16 190  PRNTCT  DCW 0377   0CO
16 200  REPHD1  DCW *      JOB LISTING-WORK BACKLOG
17 010  REPHD2  DCW *      (ACTIVATED, NCT COMPLETED)
17 020  REPHDO  DCW *      (NOT ACTIVATED)
17 030  REPHD3  DCW *      AS OF
17 040  REPHD4  DCW *      UNITS = MANHOURS
17 050  REPHD5  DCW *      * = MATERIAL ORDER REQUIRED
17 060  REPHD6  DCW *      * = HELD FOR MATERIAL
17 070  REPHD7  DCW *      JOB   FUND SOURCE   SHOP 1   SHO
17 080  REPHD8  DCW *      P 2   SHOP 3   SHOP 4   SHOP 5
17 090  REPHD9  DCW *       SHOP 6   SHOP 7   SHOP 8
17 100  ACCN55  DSA *          0550
17 110  FNDCCD  DCW 0379   0
17 120  FNDADD  DSA *          0CC0
17 130  ACCN48  DSA *          0480
17 140  REPFT1  DCW *      MANHOUR TOTALS =
17 150  REPFT2  DCW *      FUND SOURCES    1        2
17 160  REPFT3  DCW *        3        4        5        6
17 170  REPFT4  DCW *             7        8
17 180  JOBEND  DCW *      JOB COMPLETED
17 190  ERCRD1  DCW *      STOP DUE TO INCORRECT
17 200  ERCRD2  DCW *      DATE CARD
18 010  ERCRD3  DCW *      MASTER JOB CARD
18 020  ERCRD4  DCW *      JOB CARD FOR SHOP
18 030  ERCRD5  DCW *      JCB DESCRIP. CARD

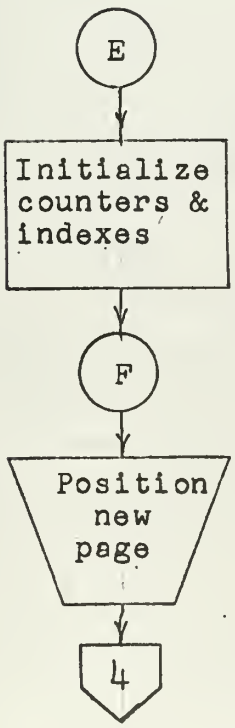
18 040          *END  START                          *
```

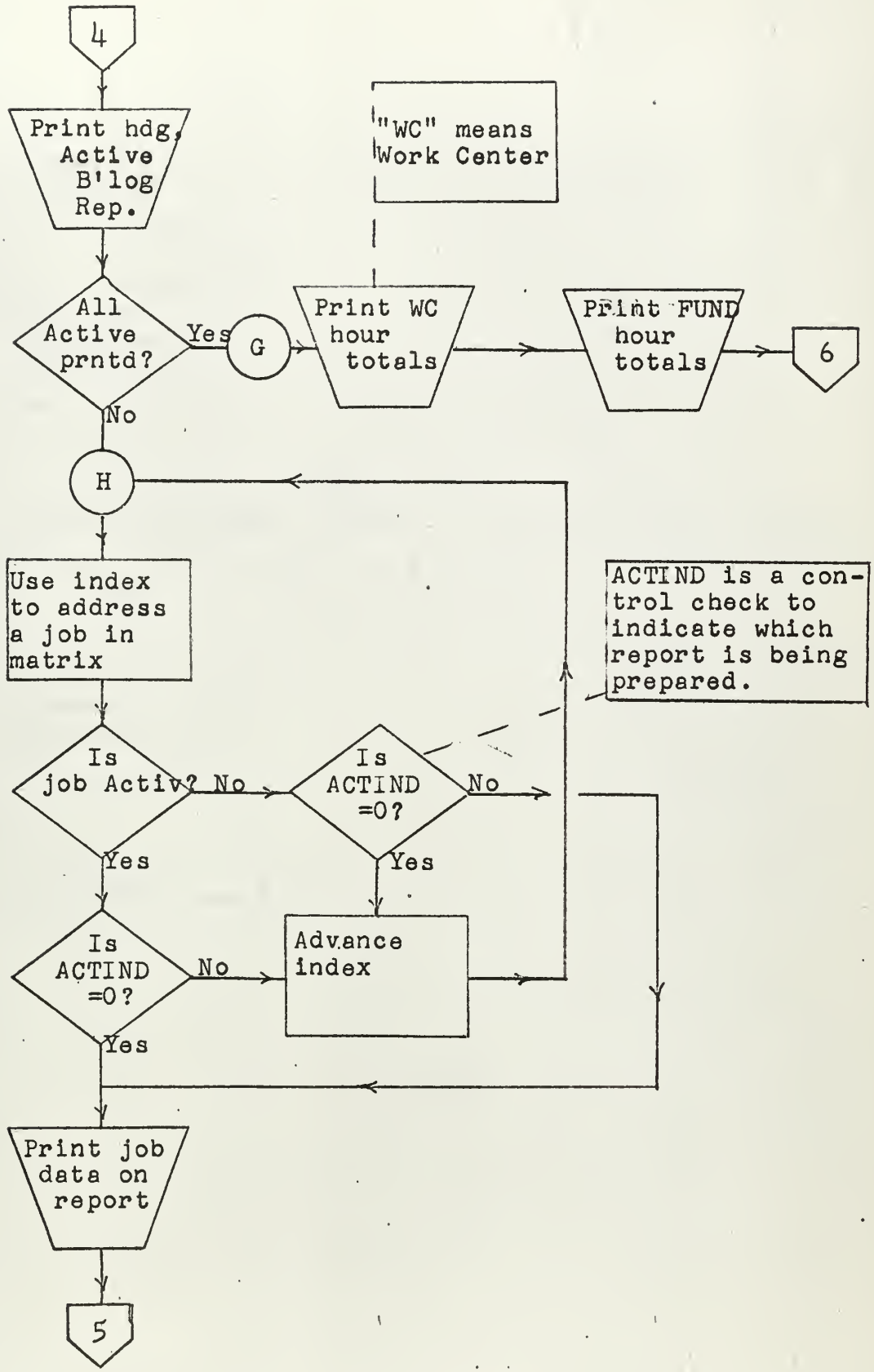

Start
Read Card & Stack 1
Date Card?
No
Print Error Msg
Stop
Yes
A
Print job listing hdg
B
Read Card & Stack 1
Blank Card?
Yes
E
No
1

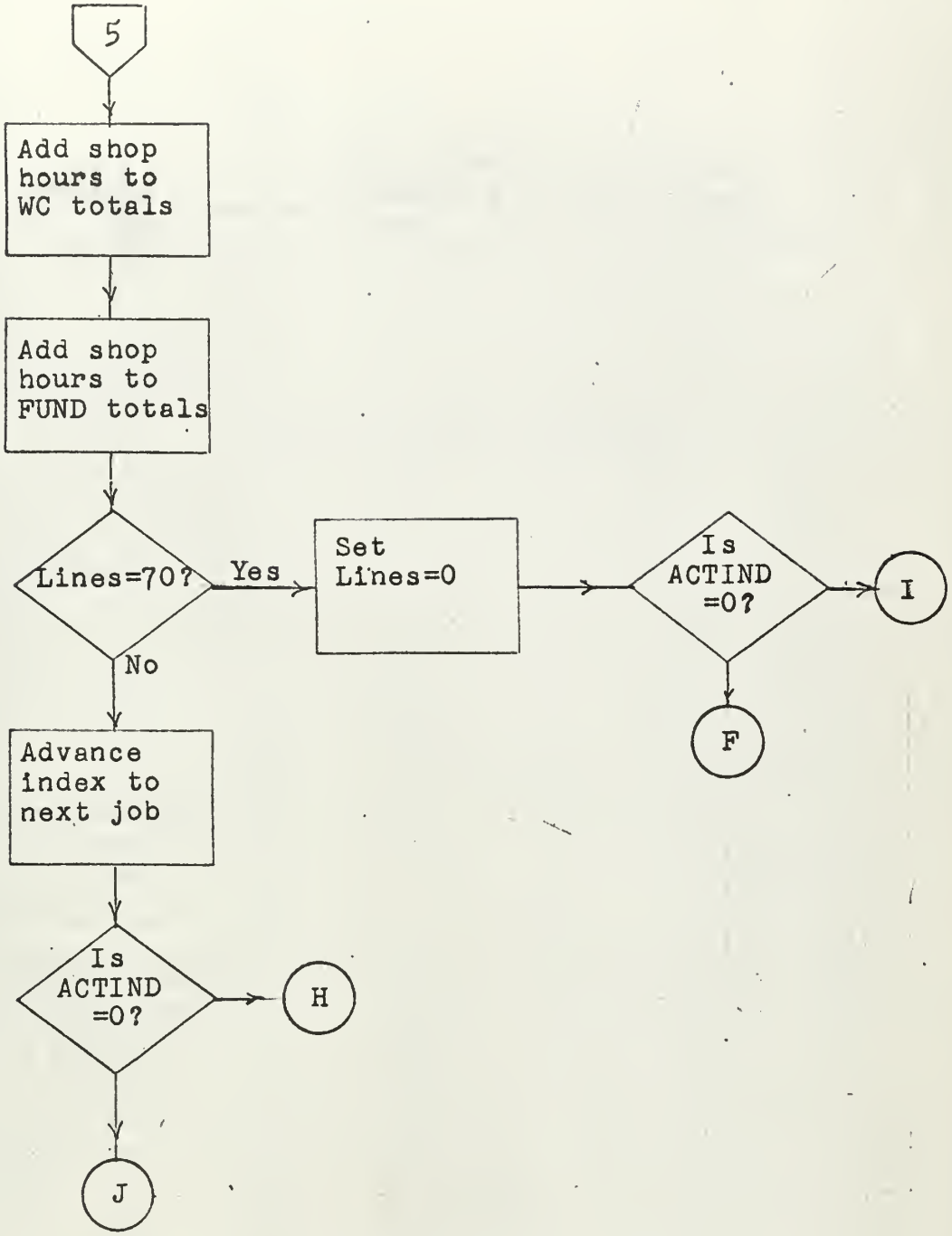

1
Master Card?
No
Print Error Msg
Stop
B
Yes
Move master to tempor-ary storage
Read Card & Stack 1
Job Descrip. Card?
No
Yes
Print 2-line job listing
Advance a lines counter
Status 6,7or9?
Yes
Cycle 8 shop crds & stk 1
D
2

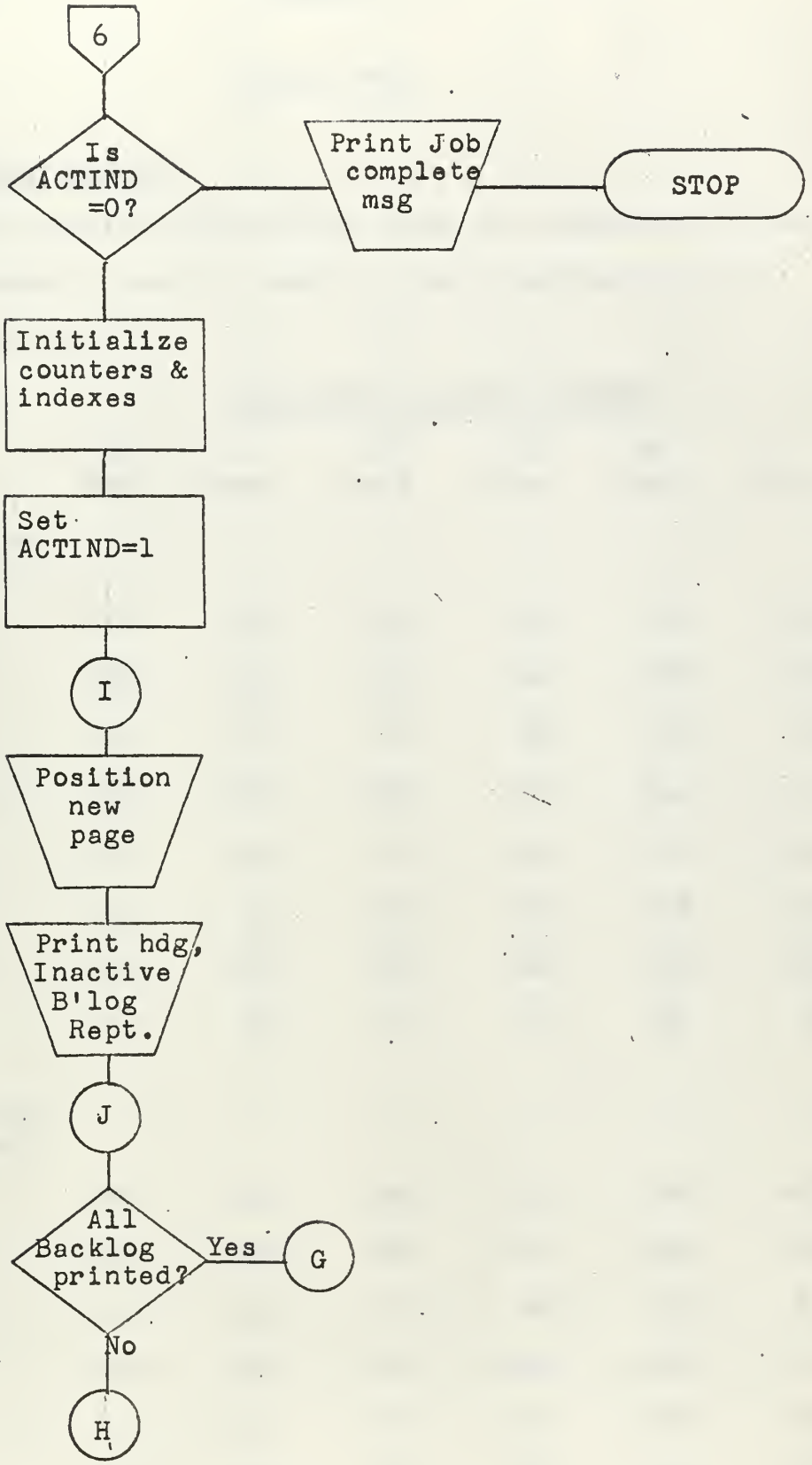

2
Move data to storage matrix
Status 1,2or3?
Yes
Advance a counter & flag as activated
No
Advance a counter & flag as not activated
Wrk Cntr counter= 1 & index= 0
C
Read Card & stack 1
Control # correct?
No
Print error msg
Stop
B
Yes
Correct shop?
No
Yes
3


3
Move hours work remaining to matrix
Advance Wrk Cntr counter & index
Wrk Cntr count=8?
Yes
D
Lines = 70?
Yes
A
No
No
C
B


E
Initialize counters & indexes
F
Position new page
4


4
Print hdg, Active B'log Rep.
"WC" means Work Center
All Active prntd?
Yes
G
Print WC hour totals
Print FUND hour totals
6
No
H
Use index to address a job in matrix
ACTIND is a control check to indicate which report is being prepared.
Is job Activ?
No
Is ACTIND =0?
No
Yes
Yes
Is ACTIND =0?
No
Advance index
Yes
Print job data on report
5


5
Add shop hours to WC totals
Add shop hours to FUND totals
Lines=70?
Yes
Set Lines=0
Is ACTIND =0?
I
F
No
Advance index to next job
Is ACTIND =0?
H
J


6
Is ACTIND =0?
Print Job complete msg
STOP
Initialize counters & indexes
Set ACTIND=1
I
Position new page
Print hdg, Inactive B'log Rept.
J
All Backlog printed?
Yes
G
No
H

APPENDIX C

SYSTEM TEST

I. Parameter values.

The following tabulation shows the parameter values used for each of the six weeks in the simulated test of the Autosked system.

Parameter	Value for the Week Ending:					
	25 May	4 June	11 June	18 June	25 June	2 July
Minimum Manhours for Fund Source						
#1	160	130	160	160	180	180
#2	630	480	630	700	680	730
#3	47	37	47	30	30	40
#4	280	230	280	300	300	300
#5	570	450	570	600	600	650
#6	120	95	120	140	140	140
#7	340	270	340	300	280	280
#8	72	57	72	75	80	75
Maximum Manhours for Fund Source						
#1	240	210	240	240	220	220
#2	930	780	930	1100	880	830
#3	67	57	67	60	50	60
#4	420	370	420	450	500	400
#5	870	750	870	900	1000	800
#6	180	155	180	200	200	200

Parameter	Value for the Week Ending:					
	25 May	4 June	11 June	18 June	25 June	2 July
#7	500	430	500	450	420	400
#8	108	93	108	115	110	120
Manhours for Work Center						
#1	390	312	390	390	390	390
#2	190	152	190	190	190	190
#3	470	376	470	470	470	470
#4	300	240	300	300	300	300
#5	140	112	140	140	140	140
#6	170	136	170	170	170	170
#7	280	224	280	280	280	280
#8	810	650	810	810	810	810
Season Codes Scheduleable	1-2-3 -4-6	1-2-3 -4-6	1-2-3 -4-6	1-2-7	1-2-7	1-2-7
Payoff Constants						
A	100	100	100	100	100	100
B	50	50	50	50	50	50
C	40	40	40	40	40	40
D	35	35	35	35	35	35
Workdays	5	4	5	5	5	5

II. Sample printed outputs.

The following pages are samples of the printed outputs generated during the system test. Only two pages of the Job Listing are presented.

ORIG. NO.	DATE	PRIOR.	FUND	JDN	RELATED CNTL NOS.	STATUS
228	FACILITY=MCASG JOB= CLEAN ALL CATCH BASINS AND DO DRAINAGE WORK.					
26	359-64	4170	5	7	00000 00229 00000	IN APPROVED BACKLOG AWAITING ACTIVATION
288	FACILITY=02014 JOB= INSTALL WIRE MESH ON 3 CELL BLOCKS					
49	17-65	4192	9	3	44006 00000 00000	ACTIVATED AWAITING SCHEDULING
740	FACILITY=2910C JOB= REPAINT LOWER FLOOR ROOMS.					
05	111-65	4200	4	5	00000 00000 00000	IN APPROVED BACKLOG AWAITING ACTIVATION
983	FACILITY=MCASG JOB= REMOVE WEEDS FROM HELO LANDINGS AND RUNDWY OVERRUNS. TERILIZE AREA.					
26	358-64	4155	5	7	40510 00000 00000	ACTIVATED AWAITING SCHEDULING
1007	FACILITY=ROADS JOB= REPAIR ASPHALT ROADS.					
10	44-65	4204	5	2	00000 00000 00000	IN APPROVED BACKLOG AWAITING ACTIVATION
1301	FACILITY= 3252 JOB= MOVE PAINT SPRAY BOOTH					
12	116-11	5111	9	1		DEFERRED BY MAINTENANCE OFFICER
1338	FACILITY=ORLPR JOB= CONSOLIDATED MINOR WORK TO REAL PROPERTY.					
16	125-65	5104	4	2	45022 00000 00000	ACTIVATED AWAITING SCHEDULING
1670	FACILITY=MISCL JOB= REPLACE ELECTRIC PANELS IN 27 Q-HUTS.					
12	9-65	4210	6	2	00000 00000 00000	IN APPROVED BACKLOG AWAITING ACTIVATION
1877	FACILITY=ROADS JOB= REPAIRS TO ROADS AND SIDEWALKS.					
09	34-65	4257	5	2	00000 00000 00000	IN APPROVED BACKLOG AWAITING ACTIVATION
2443	FACILITY=02045 JOB= MISCELLANEOUS REPAIRS AND EXTERIOR PAINT.					
11	97-64	4240	6	2	00000 00000 00000	IN APPROVED BACKLOG AWAITING ACTIVATION
2584	FACILITY= 2112 JOB= INSTALL VENILATION SYSTEM					
16	854-70	5111	5	6		REIMBURSABLE WORK PENDING APPROVAL OF REQUESTOR
2892	FACILITY= HGRS JOB= INSTALL GROUNDING SYSTEM					
12	497-38	5111	3	7	45891	ACTIVATED AWAITING SCHEDULING

ORIG. NO.	DATE PRIOR.	FUND	JOB	RELATED CNTL NOS.	STATUS
2912	FACILITY=00109 JOB= CLOSED QUARTERS.				
	05 169-65 4204	4	5	45112 00000 00000	SCHEDULED JOB CURRENT WEEK
3260	FACILITY=WATER JOB= REPAIRS TO WATER MAIN VENT PITS				
	11 867-49 5111	5	2		IN APPROVED BACKLOG AWAITING ACTIVATION
3308	FACILITY= USNH JOB= INSTALL EXHAUST FANS				
	17 568-1[illegible] 5111	9	7	40611	ACTIVATED AWAITING SCHEDULING
3314	FACILITY=2900+ JOB= TERMITE TREATMENT OF 26 BUILDINGS				
	12 18-65 4210	5	5	00000 00000 00000	IN APPROVED BACKLOG AWAITING ACTIVATION
3315	FACILITY=2900+ JOB= TERMITE TREATMENT OF 27 BUILDINGS				
	12 19-65 4210	5	5	43118 00000 00000	SCHEDULED JOB CURRENT WEEK
3410	FACILITY=GRNDS JOB= FORM AND POUR 320 CONCRETE STEPPING STONES				
	20 16-65 4210	6	5	42126 00000 00000	SCHEDULED JOB CURRENT WEEK
3522	FACILITY=00007 JOB= REPLACE TILE DECK AND WALLS IN SHOWER				
	09 144-64 4180	5	2	45104 00000 00000	SCHEDULED JOB CURRENT WEEK
3574	FACILITY=27[illegible]B JOB= CLOSED QUARTERS				
	05 1[illegible]8-6[illegible] 4279	4	2	45111 00000 00000	ACTIVATED AWAITING SCHEDULING
3962	FACILITY=24165 JOB= INTERIOR PAINTING				
	11 45-65 4299	6	2	00000 00000 00000	IN APPROVED BACKLOG AWAITING ACTIVATION
3877	FACILITY=LAWNS JOB= TRIM SHRUBBERY				
	17 1 5-65 5111	7	4		IN APPROVED BACKLOG AWAITING ACTIVATION
3934	FACILITY=HPROP JOB= PM 100 QUARTERS REEFERS.				
	17 [illegible]0-6[illegible] 5350	5	5	40712 00000 00000	ACTIVATED AWAITING SCHEDULING
3935	FACILITY=HPROP JOB= PM 90 QUARTERS REEFERS.				
	17 11-65 5330	6	4	40813 00000 00000	ACTIVATED AWAITING SCHEDULING

JOB LISTING-WORK BACKLOG (NOT ACTIVATED) AS OF 25 MAY 1965

UNITS = MANHOURS * = MATERIAL ORDER REQUIRED

JOB	FUND SOURCE	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
228	7	--	--	--	--	--	--	12	301
740	5	--	--	40	--	--	--	--	--
1007	2	--	--	--	--	--	--	--	853
1670	2	8	--	--	326*	--	--	--	--
1877	2	--	--	--	--	--	--	--	500
2443	2	29	4	100	7	--	--	--	--
3260	2	--	33	--	--	--	24	32	40
3314	5	--	--	--	--	--	--	--	857*
3862	2	--	--	417	--	--	--	--	--
3877	4	--	--	--	--	--	--	--	300
4468	7	86	--	568	--	--	--	--	--
4911	2	--	--	--	--	--	--	16	332
5004	6	280	--	40	--	--	--	32	--
5686	4	16	272	108	16	--	16	--	--
5739	6	--	--	58	--	--	--	42	8
5832	2	--	--	--	--	79	--	16	--
6591	5	300	--	--	--	--	--	840	600
7002	4	223	--	--	--	--	--	--	--
8045	6	--	--	--	--	--	--	--	206
8176	2	--	--	--	181*	--	--	--	--

JOB LISTING-WORK BACKLOG (NOT ACTIVATED) AS OF 25 MAY 1965

UNITS = MANHOURS * = MATERIAL ORDER REQUIRED

JOB	FUND SOURCE	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
8303	8	240	--	--	--	--	--	24	--
8390	6	--	--	--	--	64	--	32	--
8518	2	--	--	--	--	--	210*	--	--
8558	5	--	24	8	8	--	145*	8	--
8575	5	--	24	8	8	--	145*	8	--
8783	2	--	145	30	--	--	--	--	60
8798	2	24	16	8	16	16	32	16	--
8817	2	--	--	--	--	--	98	42	--
8880	2	87	3	43	36	--	48	11	32
9055	3	4	--	--	16	--	--	16*	--
9315	6	--	24	270*	--	--	--	--	--
9664	1	--	--	--	--	--	--	528	--
9685	8	--	--	--	--	--	--	--	352
9709	2	51	--	20	--	--	--	24	--
9858	1	--	--	--	--	--	160	64	48
9897	1	200	--	--	--	--	--	16	--
10088	5	--	--	120	--	--	--	--	--
10330	5	72	24	5	74	--	48	10	36
10331	5	286	128	136	2	--	--	60	188
10770	2	--	--	--	--	--	--	--	198

JOB LISTING-WORK BACKLOG (NOT ACTIVATED) AS OF 25 MAY 1965

UNITS = MANHOURS * = MATERIAL ORDER REQUIRED

JOB	FUND SOURCE	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
10882	2	--	--	--	--	--	--	--	128
MANHOUR TOTALS =		1906	697	1979	690	159	926	1649	5039
FUND SOURCES		1	2	3	4	5	6	7	8
MANHOUR TOTALS =		816	4391	36	951	4212	1056	967	616

JOB LISTING-WORK BACKLOG (ACTIVATED, NOT COMPLETED) AS OF 25 MAY 1965

UNITS = MANHOURS * = HELD FOR MATERIAL

JOB	FUND SOURCE	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
288	3	--	--	--	--	--	--	106*	--
983	7	--	--	--	--	--	--	--	960*
1338	2	58	--	26	24	--	19	8	--
2892	7	--	--	--	24*	--	--	32*	270*
2912	5	76	103	118	4	--	--	13	47
3308	7	48	--	8	40	--	--	--	--
3315	5	--	--	--	--	--	--	--	474
3410	5	--	--	--	--	--	--	--	200
3522	2	--	500	--	--	--	48	24	120
3574	2	2	--	44	--	--	--	--	--
3934	5	--	--	--	--	167	--	--	--
3935	4	--	--	--	--	144	--	--	--
3967	6	--	--	--	56	--	--	--	40
4465	4	102	20	560	--	--	--	--	--
4766	1	--	--	--	--	518	16	8	--
4824	2	542*	--	--	64	--	--	64	280
4926	7	--	--	--	288*	--	--	16*	--
4961	4	--	--	--	--	--	--	155*	--
5374	8	32	--	3	32	64	--	--	--
5887	2	--	--	--	--	32	--	--	--

JOB LISTING-WORK BACKLOG (ACTIVATED, NOT COMPLETED) AS OF 25 MAY 1965

UNITS = MANHOURS * = HELD FOR MATERIAL

JOB	FUND SOURCE	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
6247	2	51	16	22	6	--	36	44	--
6705	3	24	--	6	--	--	--	--	16
6934	7	40	48	1199*	48	--	72	--	--
7073	2	200*	--	--	16	32	--	32	16
7751	3	71	--	18	53	4	--	--	16
8073	5	--	--	--	--	--	--	--	256
8177	2	12	--	--	--	--	4	2	--
8330	2	2	--	164	--	--	--	--	--
8494	2	95	--	68	--	--	--	--	--
8560	5	--	24	28	18	--	145*	18	--
8772	7	32	--	--	2*	--	--	56	--
8999	3	74	8	32	54	--	51	6	--
9489	2	44	--	162	--	--	--	33	--
9611	2	9	--	31	--	--	4	2	38
9703	1	--	--	--	54	--	64	16	--
9742	1	9	24	--	20	80	--	--	--
9945	4	8	40	--	--	--	32	--	40
10089	5	--	--	--	--	--	--	--	160
10547	8	56	4	8	48	8	--	24	--
10582	2	--	--	--	--	160	16	16	--

JOB LISTING-WORK BACKLOG (ACTIVATED, NOT COMPLETED) AS OF 25 MAY 1965

UNITS = MANHOURS * = HELD FOR MATERIAL

JOB	FUND SOURCE	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
10754	6	--	--	--	--	--	200	--	--
10767	2	24	--	6	--	--	--	--	--
10821	5	32	--	90	--	--	--	--	--
10823	2	131	8	24	34	18	10	--	--
10884	4	--	--	--	1335	--	--	--	--
11085	5	--	--	--	--	--	--	170	--
11667	1	--	--	--	--	--	--	160*	--
MANHOUR TOTALS =		1773	795	2717	2220	1227	717	1005	2933
FUND SOURCES		1	2	3	4	5	6	7	8
MANHOUR TOTALS =		969	3442	539	2536	2143	296	3183	279

TENTATIVE SHOP WORK SCHEDULE FOR THE WEEK ENDING 4 JUNE 1965

UNITS = MANHOURS

JOB	FUND	PAYOFF	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
10821	5	831	FIN	--	90	--	--	--	--	--
10823	2	767	87	FIN	24	FIN	FIN	8	--	--
10884	4	701	--	--	--	92	--	--	--	--
11085	5	338	--	--	--	--	--	--	45	--
11667	1	701	--	--	--	--	--	--	64	--
MANHOUR TOTALS =			312	60*	376	240	112	136	183*	650
FUND SOURCES			1	2	3	4	5	6	7	8
MANHOUR TOTALS =			205	482	57	254	543	80*	416	32*

* = INSUFFICIENT ACTIVATED WORK TO MEET SPECIFIED REQUIREMENTS

TENTATIVE SHOP WORK SCHEDULE FOR THE WEEK ENDING 4 JUNE 1965

UNITS = MANHOURS

JOB	FUND	PAYOFF	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
288	3	280	--	--	--	--	--	--	18	--
983	7	370	--	--	--	--	--	--	--	146
2912	5	752	76	20		FIN	--	--	FIN	47
3315	5	705	--	--	--	--	--	--	--	152
3410	5	675	--	--	--	--	--	--	--	40
4465	4	668	FIN	FIN	49	--	--	--	--	--
4766	1	772	--	--	--	--	112	16	FIN	--
4824	2	752	27	--	--	16	--	--		192
4926	7	840	--	--	--	132	--	--	FIN	--
4961	4	647	--	--	--	--	--	--	41	--
5374	8	420	32	--				--	--	--
6247	2	755	51	FIN	22	FIN	--		FIN	--
6834	7	701		FIN	138	FIN	--		--	--
8073	5	754	--	--	--	--	--	--	--	73
8999	3	638	39	FIN			--		FIN	--
9489	2	674	FIN	--	53	--	--	--	FIN	--
9611	2	341		--		--	--		2	
9703	1	752	--	--	--		--		13	--
9945	4	836	FIN	40	--	--	--	32	--	FIN
10754	6	834	--	--	--	--	--	80	--	--

SHOP WORK SCHEDULE FOR THE WEEK ENDING 4 JUNE 1965

UNITS = MANHOURS

JOB	FUND	PAYOFF	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
283	3	280	--	--	--	--	--	--	16	--
983	7	370	--	--	--	--	--	--	--	160
2912	5	752	76	20		FIN	--	--	FIN	47
3315	5	705	--	--	--	--	--	--	--	148
3410	5	675	--	--	--	--	--	--	--	41
4465	4	668	FIN	FIN	65	--	--	--	--	--
4766	1	772	--	--	--	--	112	16	FIN	--
4824	2	752		--	--		--	--		160
4926	7	845	--	--	--	147	--	--	FIN	--
4961	4	647	--	--	--	--	--	--	42	--
5374	8	420	20	--				--	--	--
6247	2	755	51	FIN	22	FIN	--	5	FIN	--
6834	7	701	22	FIN	101	FIN	--		--	--
7751	3	368		--				--	--	4
8073	5	754	--	--	--	--	--	--	--	66
8177	2	702	12	--	--	--	--		2	--
8999	5	638	35	FIN	2		--		FIN	--
9489	2	674	FIN	--	72	--	--	--	FIN	--
9611	2	341		--		--	--		2	24
9945	4	836	FIN	40	--	--	--	32	--	FIN

SHOP WORK SCHEDULE FOR THE WEEK ENDING 4 JUNE 1965

UNITS = MANHOURS

JOB	FUND	PAYOFF	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
10754	6	834	--	--	--	--	--	73	--	--
10821	5	831	FIN	--	90	--	--	--	--	--
10823	2	767	96	FIN	24	FIN	FIN	10	--	--
10884	4	701	--	--	--	93	--	--	--	--
11085	5	338	--	--	--	--	--	--	45	--
11667	1	701	--	--	--	--	--	--	64	--
MANHOUR TOTALS =			312	60*	376	240	112	136	171*	650
FUND SOURCES			1	2	3	4	5	6	7	8
MANHOUR TOTALS =			192	480	57	272	533	73*	430	20*

* = INSUFFICIENT ACTIVATED WORK TO MEET SPECIFIED REQUIREMENTS

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